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The Coming Struggle for Sea Power

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(The following article by Mr. Bywater, the noted naval expert of the "London Daily Telegraph" is reproduced from the October number of "Current History.")

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SOME time next year the five leading maritime powers will again foregather to discuss the limitation of their respective naval armaments. Preliminary conversations between them have already begun, for it is recognized that unless the ground is prepared beforehand the forthcoming conference must inevitably fail. And failure would be serious. The whole question of world disarmament has reached a critical, perhaps a crucial stage, and upon the decisions taken in the next twelve months may depend not merely the continuation or end of the system to regulating combatant forces by negotiation but the maintenance of peace itself.

So far as the naval problem is concerned the conditions now obtaining are fundamentally different from those of 1921, when the Washington conference was held. Thirteen years ago the only three powers that counted at sea were the British Empire, the United States and Japan. The first possessed a fighting fleet of overwhelming strength, though part of it was obsolescent; the second and third were engaged in a neck-and-neck building race which, had it been run to finality, would have left them practically equal in modern battleship tonnage. But the pace was too hot to last. To the American taxpayer the naval race was becoming irksome; to the Japanese taxpayer it was ruinous. It is not disrespectful to say that France and Italy hardly counted at that time, when the battleship was the only face card and the superdreadnought the only trump.

Passing over the abortive parley at Geneva in 1927, where, as we now know, the armament firms held statesmanship fast in a clove-hitch, we come to the London conference of 1930. It began as a five-power meeting, but at the critical moment France and Italy withdrew, and the treaty that eventually emerged was confined to the "big three." This was the first breakaway from the cardinal principle that disarmament, to be effective, must be universal. The only reason why any sort of agreement was reached in 1930 was that Great Britain had a Socialist government which was anxious for party purposes to achieve a spectacular coup in the realm of high politics. To accomplish this they were prepared to go to almost any length in the making of concessions, and they did, in fact, give away British naval assets with both hands without receiving, or even demanding, a satisfactory *quid pro quo.*

London Treaty Condemned

By an overwhelming majority of Britons the London Naval Treaty is now condemned as an inexcusable blunder, the consequences of which cannot yet be measured. It is a mistake never likely to be repeated. At the next naval conference Great Britain may be trusted to drive a hard bargain in exchange for any reduction she may be invited to make.

The comparatively facile success of the Washington conference seems to have led many people on both sides of the Atlantic to assume that competition in naval armament had been permanently arrested. They did not pause to consider the quite exceptional circumstances in which it was held. So far as the European powers were concerned, war weariness and the threat of insolvency put them in the mood to accept any arrangement which promised to ease the burden of armaments without unduly jeopardizing their security; and even in America and Japan there was an incipient revolt against the lavish expenditure on battleships. It was, therefore, not a very difficult matter to draft a treaty for the limitation of these costly weapons. But at the first attempt to extend similar restrictions to smaller and cheaper fighting craft, including submarines, trouble was encountered. On this point no agreement could be reached, nor have negotiations during the subsequent years been successful.

Since the Washington conference political events have occurred in various parts of the world which have changed the whole aspect of naval disarmament. In 1922 the Fascist revolution reinstated Italy as a great power and incidentally gave a new turn to her naval policy. In the same year the first French post-war shipbuilding program was introduced, the precursor of the famous Naval Statute which has already restored the navy of France to its traditional plane of importance. In 1924 the British Parliament authorized five new cruisers to replace obsolete units. They were of the heavy class, armed with 8-in. guns, to which the Washington conference had given its benediction. Japan had already adopted this type and in 1924 had six such vessels on the stocks.

That year, too, witnessed the American-Japanese controversy on Asiatic immigration, which seriously disturbed the harmonious relations that were supposed to have been established at the Washington conference. It may have been a mere coincidence, but the fact is on record that this dispute was followed by an energetic development of Japanese naval armaments, over twenty new vessels being started in the ensuing twenty months.

Meanwhile, the rapid expansion of the French and Italian navies, coupled with Japanese activities, impelled Great Britain to embark upon a systematic rebuilding of her fleet. In 1925 Parliament voted a five-year program embracing sixteen 8-in. gun cruisers and many smaller craft. This project was never completed, eight of the cruisers being canceled at later dates as a disarmament "gesture." To-day all parties in Britain except the Socialists and Radicals are definitely opposed to further reduction in the strength of the navy. The apathy which prevailed for more than ten years after the war has given place to a keen public interest in matters of defense. The preparations for celebrating "Navy Week" this year on a scale never previously attempted, the increase in this year's navy budget, the addition of 2,000 to the personnel of the fleet and the decision to build heavier cruisers capable of holding their own against the best foreign ships—all these are symptoms of a return to a strong and purposeful naval policy, solidly backed by public opinion. There are to be no more sentimental gestures involving sacrifices without compensation, no further experiments in unilateral disarmament.

To arrive at a clear understanding of the current naval situation it is necessary to review in some detail the problems and policy of each of the five powers chiefly concerned. It will be convenient to begin with Great Britain. Her position is unique, for not only is she an island which depends on the sea for sustenance, but she is the head and heart of a vast commonwealth scattered over the globe, each member of which looks to her for protection and security.

None of the oversea members of the commonwealth is capable of defending itself against serious aggression. An empire of this magnitude is necessarily vulnerable at many points, and while every war has its decisive theater no war is conceivable in which Great Britain could safely concentrate the whole of her naval strength in one area. That is why the acceptance of a one-power standard of strength is bound to entail risk.

The British Position

As for the functions of the British Navy, they have been tersely defined by the First Lord of the Admiralty in a recent speech. "Every day 110,000 tons of merchandise and 50,000 tons of food reach the shores of Great Britain from overseas. They come over 80,000 miles of sea routes, and unless we secure their safe arrival we starve. The protection of our sea routes, for the safe arrival of our merchandise and our food, is the business of the navy." The British people have not forgotten that in the Summer of 1917, when the German U-boat campaign was at its height, there remained in their country only six weeks' supply of food. No other country is so exposed to the threat of sudden starvation in war.

Leaving out the United States, there are at least four powers whose naval armaments must be a matter of vital concern to Great Britain. Japan is in a position to conquer her Far Eastern possessions, paralyze her trade in that zone, and menace Australia and even India. Were trouble to develop with Japan, Britain would have to wage a naval campaign 10,000 miles from her home bases. France, with three times as many submarines as Germany possessed in 1914, a score of high-speed cruisers, and numerous ports on the Channel, Atlantic and Mediterranean which it would be impossible to blockade, is in an ideal position to sever Britain's lines of communication and reduce her to famine. Italy, almost equally well equipped with submarines, cruisers and aircraft, would have no great difficulty in closing the Eastern Mediterranean to British shipping, an act that would cause freights to soar and speedily put Britain on short rations. Germany has a small but highly efficient navy, the rapid expansion of which is believed to be only a question of time. Even to-day her pocket battleships and cruisers, with a sea endurance of 15,000 to 20,000 miles, could play havoc on the trade routes, and it is for Britain a disconcerting fact that she has only three warships capable of dealing with the pocket battleship type. Nor is it any secret that Germany has planned the mass production of submarines when needed.

U.S. Naval Policy

The naval policy of the United States is apt to bewilder the foreign observer. He is intelligent enough to realize that a great power, the wealthiest in the world, with an immense seaboard fronting two oceans and a foreign trade to the expansion of which there is no visible limit, must of necessity have a navy of the first class. Obviously, the dimensions of that navy must be determined by the United States alone, subject to such international agreements as it may see fit to endorse. Nothing, one imagines, could be more exasperating to the patriotic American than foreign attempt to suggest, if not dictate, the limits to which the United States Navy should be developed.

Nevertheless, it is true that the United States, if called upon to state its reasons for demanding a navy second to none, would have to appeal to academic rather than to concrete principles. Separated from Europe and Asia by the width of oceans, it is in no danger of direct attack on a serious scale, nor could it be blockaded in any literal sense of the word. The Philippines are a dangerous liability so long as they remain under the American flag, but after they become independent and the Asiatic Squadron is withdrawn, as now seems likely, the United States will have an invulnerable naval defense. Washington then might view the development of Japanese, French, Italian and even British sea power with Olympian calm and detachment, though considerations of prestige might still justify the maintenance of a United States fleet second to none.

This rather provocative statement is made deliberately. In the past the United States has exhibited a tendency to fashion its own yardstick of international naval armaments and to become annoyed when other parties look askance at the suggested system of rationing tonnage. It is advisable, therefore, to say quite frankly that a nation which is singularly free from the threat of attack is not necessarily the best judge of the defensive requirements of less-favored countries. The British Empire, Japan and Italy, and France in less degree, could one and all be subjugated and forced to surrender in months, if not weeks, by the pressure of superior sea power. In no imaginable circumstances could the American nation be brought to its knees by similar means.

Probably under the delusion that all naval competition had been ended by the Washington treaty, the United States for several years thereafter made no addition to its fleet. During the same period, however, all the other treaty powers were steadily reinforcing their armaments at sea, Great Britain being the last to join in. Soon, therefore, the United States found its relative strength declining. There followed an outcry against the other powers for starting a new naval race, though in fact, by systematically restoring their depleted fleets, they were only obeying the instinct of self-preservation. Each was scrupulously observing the Washington treaty rules and none made any attempt to exceed its legal quota in the categories of restricted tonnage.

Eventually, of course, the United States also had to resume building. Six heavy cruisers were begun in 1928 and authority was obtained for a larger program in the event of further disarmament negotiations proving futile. Finally, in 1930, the London treaty established definite quotas for all classes of naval tonnage in the case of Britain, the United States and Japan, but as France and Italy stood aloof, this arrangement, it was clear could only be temporary. In consequence, the new treaty was scheduled to expire at the end of 1936.

It was a strangely one-sided compact. While, for example, Britain bound herself not to complete more than 91,000 tons of new cruisers in the period covered by the treaty, no similar obligation was laid upon the United States or Japan. Here, then, is a typical example of the secret diplomacy practiced by the British Socialist leaders whose determination to score a party triumph blinded them to the higher claims of national security. As a sop to the Admiralty and to that section of the public which might protest against the uncompensated surrender of naval assets the "escalator" clause was inserted. This authorizes a signatory power to go beyond its tonnage quota in the event of a neighboring State, not a party to the pact, becoming a potential menace by reason of excessive naval building. Actually this safeguard is illusory, since invocation of the clause in question would invite a dangerous crisis.

Puzzled by U.S. Policy

Suppose, for instance, that Great Britain, finding that both France and Italy had doubled their submarine fleets since the treaty—as indeed they have—resolved to build an additional 50,000 tons of anti-submarine craft by taking advantage of the escalator clause. As a first step she would have to notify her treaty partners, the United States and Japan, and justify her proposed action by indicting France and Italy as prospective enemies. It would be impossible to keep the ensuing correspondence between London, Washington and Tokyo a secret, and the effects of the disclosure on Britain's relations with her continental neighbors may readily be imagined. Eighteen months ago the British Premier told a peace deputation that if professional, that is, Admiralty, advice had been taken, the escalator clause would have been invoked in 1932. That this was not done is a tacit admission that as a safeguard the clause is worthless.

As I have remarked, American naval policy is somewhat puzzling to the foreigner. For several years the United States may not lay a single man-of-war keel; then there comes a strenuous publicity campaign to rouse country and Congress, and eventually a big program of new construction is put in hand. This completed, another prolonged period of inactivity ensues; the relative strength that had been gained is gradually lost and once more there is hurried building on a large scale to restore the balance. Such a policy inevitably creates a false impression abroad and it is open to any foreign critic to one of these big programs—such as the N.R.A. measure of 1933 and the Vinson bill of 1934—as evidence that the United States, while preaching the virtues of disarmament to others, is actually inaugurating a new naval race. Intelligent observers know this charge to be unfair, but for propaganda purposes the fact that the United States has authorized over 130 new fighting ships in twelve months can be exploited with telling effect.

About Japan's naval policy there is nothing obscure or ambiguous. Its object is so to consolidate her strategic position as

to render armed foreign interference in Eastern Asia physically impossible. That goal is now in sight, if it has not already been attained. Japan keeps no warships in foreign waters, nor does she possess oversea bases other than the mandated South Sea Islands. Her whole naval force is concentrated in home waters, where, thanks to geography and a first-class fleet, her position is practically impregnable. Judging from experience, no argument however plausible, no gesture however persuasive, will move her to reduce her naval armament by a single ton or a single gun below the standard which she deems necessary. On the contrary, having obtained a 3-5 ratio of strength at Washington, subsequently increased to 3½-5 at London, she is now demanding "parity in principle" and, by all accounts, will be satisfied with nothing less.

For reasons not wholly apparent to the outer world Japan professes to regard the year 1935 with grave apprehension. In that year, it is true, the next naval conference is to be held, and almost simultaneously Japan's withdrawal from the League of Nations will become definitive. On the face of it, however, there is nothing to indicate that tragic consequences will follow either event. Japan may, of course, anticipate a demand for the retrocession of the former German islands in the Pacific which she holds under the League's mandate and which are now considered to be important bastions in her rampart of defense. But if such a demand were raised it would probably be a mere formality to save the face of the League, since no one imagines that Japan would comply with it. As for the naval conference, a Japanese claim to parity would doubtless be resisted by Great Britain and the United States, but even so there would be ample scope for compromise. It is precisely because world naval policies are conflicting that these periodical armament talks are held, the object being to map out a multilateral policy acceptable to all and thus avoid, or at least modify, the frankly competitive shipbuilding which is a danger to peace.

Japan Master in Pacific

If the reported intention of the United States to evacuate the Philippines and withdraw its naval forces to Hawaii is actually carried out, the principal cause of armament rivalry with Japan will disappear, for the two fleets would then be so far apart as to render battle contact all but impossible. Such a development would materially weaken the Japanese case for a still larger navy, since she would then be left in unchallenged command of the Western Pacific. As every student of strategy is well aware, Japan's mastery of her own waters is already absolute. Nevertheless, the presence of an American squadron at Manila is always a convenient pretext for Japanese big-navy propaganda.

Neither France nor Italy is expected to be an enthusiastic participant in next year's conference. They know that one of its chief objects will be to limit the production of submarines and light surface craft—the very types to which they are most partial. Both declined to accept any restriction on tonnage at the London parley, and there is nothing to indicate any change in their attitudes. Each power is creating a most formidable submarine fleet. France has 109 boats and Italy 65, the majority of which are of up-to-date design. These totals are sufficient to explain why Great Britain could not in any circumstances agree to an extension of the London treaty in its present form, escalator clause or no escalator clause.

In both France and Italy naval defense is receiving much more attention than formerly. The first is determined to be mistress of the Mediterranean, mainly because of her vital lines of communication with North Africa, her principal reservoir of military manpower. Further, the renaissance of the German navy is viewed with growing anxiety and has already prompted France to lay down two 26,500 ton battleships at a cost of more than $30,000,000 apiece. It is typical of the close inter-relationship of naval armaments that this step by France, although directed against Germany, has impelled Italy also to order two battleships. Political conditions to-day are such that the laying of a man-of-war keel almost anywhere is apt to produce repercussions "from China to Peru."

As foreshadowed by official statements and unofficial clues, the programs of the various powers to be presented at next year's conference will approximate to the following summary:

The British Empire: Further reductions of naval armaments must be absolutely conditional on the agreement of all powers concerned, not merely two or three of them. In other words, unless the three-power treaty negotiated at London in 1930 can be extended to cover France and Italy, Great Britain will not renew it. Nor will she be disposed to perpetuate the existing ratios of cruiser and other light tonnage without drastic reduction of the French and Italian submarine and light forces. On the contrary, if those forces are to remain at their present strength, Britain will insist on a substantially higher ratio of counter-tonnage. She advocates a trenchant scaling down in the size and armament of all combatant craft. The battleship standard, now at 35,000 tons and 16-in. guns, should be lowered to 25,000 tons and 12-in. guns, or, subject to corresponding cruiser restriction, to 22,000 tons and 11-in. guns. The present cruiser standard of 10,000 tons and 8-in. guns should be 7,000 tons and 6-in. guns. Battleships and cruisers of these smaller types would, it is claimed, be perfectly competent to perform all reasonable functions. The submarine should be totally abolished, or, alternatively, limited to 250 tons, which would restrict its operations to coastal defense and disqualify it to act as a commerce raider on the high seas. Finally, British favors some form of control over naval aircraft, which for the present are not restricted by treaty.

U.S. Wants Sweeping Cut

The United States is expected to propose a sweeping *pari passu* cut in the strength of all navies concerned, probably by one-third. It is sympathetic in principle to British views on the submarine, but does not desire any reduction in the size or armament of battleships and cruisers, holding that the present standards, which involve heavy building costs, are the best deterrent to unbridled competition, besides being suited to American strategic requirements.

Japan will denounce the Washington-London ratios and demand full parity, in principle, with Great Britain and the United States. The Japanese will insist on the confirmation of Article 19 of the Washington treaty (forbidding development of Pacific insular fleet bases) and will certainly makes this a fundamental condition of any new pact. They will urge the total abolition of aircraft-carriers on the ground of their essentially aggressive character. Japan fears these ships more than any other naval craft. She dreads the possibility of large enemy carriers streaming across the Pacific to send off swarms of bombing planes against Tokyo and other populous centers, where heavy-calibre bombs would cause indescribable devastation amid the lightly built sections. Although wedded to the submarine, which she has energetically developed, Japan might be prepared to accept further restriction of this arm in return for some sort of embargo on aircraft-carriers. As regards battleships and cruisers, she favors modified dimensions somewhat on the British plan, but has made it clear that if future American ships are built to existing treaty standards she will follow suit.

France will take a strong line at the conference and, most probably, decline to consider proposals for the limitation of her light forces, whether submarine or surface. It is to be feared that political friction may be engendered, since Great Britain will undoubtedly press for such limitation and make it a bed-rock condition not merely of any further scaling down of British naval armaments, but for their maintenance at the present and in expert opinion wholly inadequate standard. While willing to confirm, in principle, the Italian demand for equality, France is privately determined to maintain a substantial lead over the Italian fleet, and for that reason, if for no other, is certain to press for light-tonnage quotas far in excess of the maximum to which Britain could agree.

Italy's Policy Outlined

Italy's policy, enunciated at the London parley in 1930, has undergone no serious modification. Its guiding principle is unqualified parity with France. In other words, the French maximum of combatant power at sea automatically becomes the Italian minimum. That Italy is not bluffing is demonstrated by the truly marvelous development of her navy in the last ten years. In cruisers she has built keel-for-keel against France, in submarines and destroyers she is creeping up to the French level, and by her bold decision to build this year the two largest battleships in the world she has canceled the French margin in heavy tonnage. If these two powers are represented at the conference, fireworks are inevitable.

(*Continued on page 489*)

Realities in the Far East

By WILLIAM NUNN, M.P. in "The Asiatic Review"

FOR some months past the Far East has been attracting increasing attention. Letters from old Eastern hands have been appearing in the Press in rising numbers; special correspondents have been on the move; Japan has made a statement of policy, and withdrawn it in a half-hearted way in order to placate outside opinion; and there has been growing disquietude about the relations between Japan and Russia. The Far East is definitely becoming "news."

It is at this stage, before the news value of Far Eastern affairs has soared so high as to indicate that a serious crisis has arisen, when nothing can be done but to stand aside and watch the conflagration burn itself out disastrously, or, if fortune be kinder, help to patch up some panicky haphazard settlement, that there appears to be available the last opportunity this country will have of exerting her influence in the interests of good government and peace.

But we need to know our own minds; to know for what we stand; to have a policy. The Far East to-day holds the view that we have no policy; that we are merely waiting upon events; and that if we attempt to exert any influence that influence will be negligible because it will be actuated by the impulse of the moment. Japan, although willing and indeed, it seems, anxious to be friendly, considers that we have lost touch with realities, and that we no longer count. She sees us enmeshed in Internationalism, befogging our national spirit in the atmosphere of conferences, cautiously following instead of leading.

Japan is too remote from European problems to have developed any strength of international feeling. She alone among the participants in the war was little changed in spirit by her experience, because her sufferings were insignificant. Her eyes are directed to the realities of the situation at her very doors, and she has little understanding of, and therefore little sympathy with, the new spirit of the West, which to her seems to be a spirit of compromise and indecision. Setting aside any Imperialistic ambitions she may have, there can be little doubt that she sees herself as the lonely guardian of peace in the Far East.

Her sense of power has been quickened by her remarkable industrial development and her freedom from internal disorder. Her pride in the strength of her own right arm has been increased by the weakening of Western prestige, and particularly by the loss of prestige which Great Britain has suffered throughout the East. The idealism and altruism which have actuated British policy in those areas during the past ten years appear to be, in Japan if nowhere else, the weakness of a people which has lost its hold upon reality and is drifting.

As for China, the Shanghai incident and the lamentable failure of the League of Nations over the Manchuokuo affair convinced China that the West has no help to give her; while the Hankow incident, which evoked the openly expressed contempt of the Chinese, and the abortive negotiations for the abandonment of extraterritorial rights, confirmed Chinese opinion that Great Britain's strength and interest in China were founded only upon her hope of profit. There can be no doubt that the view held by leading Chinese is that no help can be expected from this country if China should be threatened by its powerful neighbor.

Even if the Imperialism of Japan should take an extreme form it is hardly conceivable that the most Imperialistic Japanese could entertain the idea of subjugating China. A process of lopping might, indeed, be undertaken, but if it were, the lopped areas would still remain Chinese in spirit and in fact. There is no people which can offer such a dead weight of resistance to the submergence of its national characteristics. But a process of lopping might well result in Japanese control being secured of the avenues of Chinese trade, of the direction of its government, and of the application of its influence. Such a process, undertaken little by little, could not be resisted effectively by China by force of arms. The handful of courageous men who control the government of Nanking are limited in their power. Although they constitute a "People's Government" they have no great nation-wide mass of popular support behind them. Apart from the fact that they are no more democratically elected than were the old Imperial rulers of China, the bulk of the people they rule have little interest in forms of government, so long as their humble industrious lives are not disturbed and they may live in peace and quietness. The untutored masses of China, as yet ignorant of the manifold blessings which may follow in the train of political enlightenment, would accept any form of government which brought to them freedom from the horrors of famine and the scourge of warfare and banditry, equal justice, markets for their produce, and security for their meagre earnings.

The government at Nanking has not only this national apathy to face; it has its active political opponents, in whose hands the Japanese position is a strong card; and it has to meet the constant drain upon its financial resources caused by the military operations which are necessary to maintain its power on its outer marches or prevent the Sovietized areas from encroaching upon its authority. Add to this the cost of carrying out the reforms in administration to which the government has set its hand, a cost which is all the heavier because the disturbed condition of the country makes effective administration more difficult; add the expense of flood relief and road-making, in which great strides have recently been made; allow for the desperately impoverished state of the people, and for diminished trade and shrinking revenue; and it is obvious that China cannot meet the strain of determined foreign aggression. The inevitable result of a definite quarrel with Japan would be that the government of China would fall, and the country be plunged once again into anarchy.

The rulers at Nanking are, in the main, realists. Aided by the conviction that the West no longer counts, they recognize the strength of Japan's position and the weakness of their own; and if they could be assured that their national pride would not be humiliated the best of them would be prepared to come to agreement with Japan. Such agreement must be arrived at if China is to be saved from collapse; and it must come quickly. While there is danger of war between Japan and the U.S.S.R. the position of China grows more and more precarious. Russian influences are strong in many areas, and Soviet propaganda is widespread. War would arouse all the Sovietized influences in China, and an inconclusive or adverse result to war might end in extending Bolshevism to the shores of the Pacific. Such an end would mean the subjugation within a short time of French Indo-China and Siam, and Bolshevism would be marching with Burma. Japan stands as the great Eastern barrier against Bolshevism, and as the potential savior of Asia. Such a thought makes the menace of her perfectly natural commercial expansion a comparatively small matter. The question of real world-wide importance, the question upon which the fate of civilization may well hang, is how to bring the two great Eastern races together so that they may work hand in hand.

The outstanding obstacle to agreement between the two nations is the question of Manchuokuo. Chinese national pride has been grievously wounded, and the wound is not likely to heal any the sooner while China remembers that with the loss of territory she has suffered, also, the loss of 15 per cent of her Customs revenue, while the full burden of her foreign loan obligations remains on her shoulders. But the realists of China know that Manchuria was practically lost to her until, as a result of the Russo-Japanese War, the Japanese turned the Russians out. They know, also, that, after the Revolution, Manchuria was virtually a separate territory under the control of Marshal Chang Tso-lin; and they know that to-day Manchuokuo is still Chinese in spirit.

Recognition of Manchuokuo by the Chinese and the foreign Powers would relieve the tension immediately. It would be a bitter pill for China to swallow, and undoubtedly Nanking would find its political opponents ready to take the utmost advantage of any such proposal. But what is the alternative? The eminently practical Chinese must know that there is no alternative save to continue the existing unsatisfactory and unprofitable state of

affairs, with its ever-present possibilities of friction, and with its incitement to the Japanese to carry their operations to the extreme limit of actual annexation.

At the moment, Manchuokuo is Chinese. Its monarch is the chief representative of the old Imperial House. Its premier is a typical cultured Chinese of the old school. Its ministers are Chinese. Its people are preponderatingly Chinese. China cannot recover the territory by force of arms. She has nothing to hope for from the League of Nations, upon which she pinned her faith. Europe and America will afford her no assistance. What then does she stand to gain by her present policy ? Time will not fight her battle for her, but will rather tend to make the position more acute. The Japanese are realists too. They may grow impatient. The present situation is unsatisfactory. In the eyes of the governments of the world Manchuokuo does not exist. Danger looms on the Russian border. Would an incursion of Russian troops into Manchuokuo be an act of offence against Japan if no damage were done to Japanese property or interests ? One can see that the situation would be simplified if Manchuokuo were definitely part of the Japanese Empire. And China would lose Manchuokuo.

The loss would leave a wound infinitely more grievous than she suffers now. To many of her people, of the old school, Manchuokuo is a part of China restored to the Imperial family, whose ancestral home it is. To all China it is a territory still connected by a slender thread. While that thread holds although it is not China it is not a foreign country, but rather something in the nature of a self-governing dominion. Can the thread be strengthened without demanding of Japan a reversal of her policy ? To make such a demand would plainly be fruitless, whether or not it might be just.

When Manchuria became Manchuokuo, China lost a large amount of Customs revenue, and Manchuokuo ceased to carry its own portion of the burden of foreign indebtedness secured upon the Customs. The amount which Manchuokuo should have paid has not been appropriated by the government of Manchuokuo. It has been held in reserve, and China has been meeting the deficit out of her remaining revenue. It is conceivable that, in return for recognition, Manchuokuo might undertake to meet its loan indebtedness, as in former days, and thus lighten the burden resting upon the shoulders of China. What then would be the position of Manchuokuo in the eyes of China ? Would not that indefinable spirit, "face," be to some extent appeased, if the bargain were made in friendliness ? Nanking is realistic enough to know that such an arrangement would be much more helpful to its standing than the present *impasse*, and her historians would be aware that similar conditions, amounting to nominal suzerainty, have existed in the past in connection with territories bordering upon the old Empire. Indeed, to-day, Outer Mongolia is admittedly recognized as virtually autonomous, under nominal Chinese sovereignty and actual Soviet protection, while Inner Mongolia, still under the princes, is self-governing with direct dealings with Nanking. It would be a state of affairs true to tradition. The real value of such an understanding would be enormous. The tie between the two states would be greatly strengthened. Both peoples would feel that they had common interests : both could proceed in friendly rivalry in establishing good government within their borders : and both could look forward to the time, far distant possibly, but not unattainable, when once again they would come together. Until that time arrived each could concentrate upon its own problems, secure in the knowledge of their friendly relationship, more vigorously because of the smaller area of responsibility.

The irreconcilables of China would probably wish for all or nothing, but the realists ought to feel some degree of satisfaction that their fellow countrymen in Manchuokuo would be relieved of the menace of annexation by a foreign Power and would be maintaining their Chinese traditions under a ruler of their own blood.

The recognition of Manchuokuo would remove from the minds of many thoughtful Chinese the sense of shame which they feel for the violent breaking by Feng Yu-hsiang of the agreement made by the Revolutionary government with the Imperial family, by which the Emperor was guaranteed a revenue and sovereignty and the use of his title within his allotted territory of the Forbidden City.

China has gone some way towards recognizing reality. The difficulties which for some time deranged the postal service through Manchuokuo to Europe have been surmounted by official face-saving. Through railway traffic is now running ; and in August of this year the two governments came to an arrangement with regard to Customs traffic across the borders, an arrangement which provides for the establishment of Customs stations on the Great Wall and the passes, and which, most significantly, allows goods produced in Manchuokuo to be treated in the same way as goods of the same nature produced in China. No recognition of the present régime in Manchuokuo is entailed, but the agreement marks a happy stage in the evolution of Chinese opinion.

It does not lie within the province of any foreign Power to flout Chinese national pride by recognizing Manchuokuo before China herself is prepared to do so : but it does seem to be a worthy mission for this country, at any rate, with its long tradition of interest in China, with its present friendliness of feeling towards both China and Japan, to try to bring two countries together and relieve the dangerous tension. Is it beyond the power of our diplomacy to form the connecting link ? Are we bound to adopt an attitude of ungracious indifference because the efforts of the League were futile ? Or are we afraid to let it be known that we have a policy lest we should be accused of having interested motives ?

The policy of aloofness and waiting upon events, if it be a policy, has resulted in increasing the danger of the situation, and with every month that passes the possibilities of trouble grow stronger. The time has arrived when we must take a part, whatever other Powers may do.

There are opportunities which present themselves. There is the impending review of the Washington Conference. Despite the reluctance of the Japanese to consider the discussion of the political questions of the Pacific, such discussion is vitally necessary, and should be pressed, if only because it will bring Japan back again into the open field of diplomacy with regard to China. There is the question of the future of the government of the Municipality of Shanghai, a matter in which we are peculiarly interested and which might well serve to bring China, Japan, and ourselves into a common working partnership. There is, better still, the method of straightforward approach to both Powers in simple friendliness and good feeling. That friendliness can be shown by willingness to discuss those questions which are at issue between China and ourselves as part of the general clearing up and conditionally upon a satisfactory settlement of the relationship between China and Japan. Some of these questions affect Chinese sentiment very deeply, and while they remain unsettled the work of the Chinese government is made more difficult. Some affect the prosperity of Chinese, and British, commerce, because they give rise to a feeling of insecurity. All are vital to the well being of the only sound government China has known since the Revolution. That government, following the creed of Sun Yat-sen, who interpreted his idealism in realistic terms, requires all the help that can be given it. It has done much to build up a new state ; most of its members are men of great ability, and recognize that, for many years, progress must be slow, and limited not so much by geographical boundaries as by the borders of accepted control. Their realism is illustrated by an article written a few months ago by one of the leaders of the "People's Party" :

> "First things first : secondary issues can wait until a more favorable and appropriate moment for discussion. China's house has been set on fire in several places, and whether the outbreaks have been caused by spontaneous combustion, by accident, or by design are matters which can be investigated later. What has to be done now is to put out the flames—to save lives, and prevent the further destruction of property and consequent obstruction to the natural development of national prosperity. Those who obstruct the efforts of the fire brigade are not good citizens. Those who stand idly by without offering to lend a helping hand are little better than those who wilfully and maliciously attempt to cut the hose and prevent water being poured upon the flames."

That is the spirit which will save China if its continuance can be assured, and it is the spirit in which the government is working. We who are accustomed to be guarded and guided by governments which are single-minded, unmoved by popular clamor, and unswervingly direct in action, must not expect the same high standard of perfection at Nanking. There, there will be outbreaks of petulance, wavering, a tendency to fumble, a disposition to be suspicious, and an inclination towards pin-pricking ; but it will be found that modern China, which, after all, is the heir to traditions

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Japan and Manchuokuo

By YOSUKE MATSUOKA

(The article presented here and the one which follows it appeared in a special Japanese supplement, which was published by the "Daily Telegraph," London Conservative Daily, at the time of the departure of the special British Trade Mission to Manchuokuo. The publication of these articles in a leading British Conservative newspaper and other utterances sympathetic toward Japan appearing in other leading British publications are seen by many publicists in America, in England and on the Continent as a first step toward the renewal of the Anglo-Japanese Alliance.)

* * *

I TRUST that Anglo-Japanese friendship will continue to be a vital element in the maintenance of world peace. The abrogation of the Anglo-Japanese Alliance ten years ago marked the commencement of a reign of chaos and confusion on the Asiatic mainland. From this both Japan and Great Britain suffered severely, and no other nation has reaped any advantage. Much that has happened during the past decade would not have happened if the Alliance had been preserved.

It is inevitable, or rather natural, that friction should develop occasionally between the trade interests of our two countries. Japan, increasingly industrialized in the inevitable process of her development, could not always remain a handmaid of British industry. To any intelligent mind, however, the fact must be apparent that there exists a certain limit to Japan's potential power and natural resources as an industrial nation.

The bogy of Japan's trade menace is largely traceable to the lack of a sense of proportion. I think that British good sense and cool judgment will prevail and enable the British to estimate correctly what they ultimately have to expect in the way of trade competition from Japan. Nor will they long fail to discover the futility of any attempt on their part wilfully to check the legitimate growth of Japanese industry and trade.

The total of our import excess since the beginning of our foreign-trade relations amounts to as much as Y.4,500,000,000 to that extent we have bought more than we have sold. A large portion of this amount has gone into British pockets ; and to that extent we have contributed to the material welfare of the British people. But in order to rectify this adverse balance of trade Japan was compelled to adopt a policy of industrialization. The Japanese Government and people have united toward the realization of this aim, and so far, favored by a fortunate combination of circumstances, they have attained a measure of success with a fair promise for the future. I do not think our British friends will try to thwart our endeavors to help ourselves merely because the market for their industrial wares happens to be affected to some degree by our advancing trade. They should remember the good customer from whom they have derived profit.

Great Britain and the United States proved good friends in our time of need. We remember it always. We are ever anxious to express our feeling of gratitude, as may be seen from the part we played for the cause of the Allies during the War. I suppose our friendship may some day again prove its positive value to Great Britain.

The advent of the new state of Manchuokuo has furnished Japan with an opportunity to demonstrate to the world that she means what she says. Japan only wants to help Manchuokuo to grow into a strong and solid independent state where all peoples may enjoy the blessings of peace and good government. This, it is hoped, will incidentally arouse China to an effort to put her house in order.

Strategically, the new state will serve to minimize the possibility of a conflict between Japan and Soviet Russia, since Manchukuo is so situated as to constitute an ideal buffer state, contributing powerfully to the improvement of the general atmosphere prevailing in the regions covering the major portion of north-eastern Asia. Economically, by throwing the Manchurian market open to the trade and industries of all countries, wider avenues of employment for Japanese, Manchurian, Korean, and Chinese labor will be created. Then, last but not least, a new field of highly profitable investment will be provided for the capital now accumulating in Japan and the countries of Europe and America. Japan is in a position to answer for the safety of foreign investments.

We challenge the critics to wait and see if Manchuokuo will not develop along some such lines and become what we maintain that it will become. Here in a corner of Asia there will arise, within the lifetime of most men now living, a civilized state solidly founded and well equipped.

The alliance with Manchuokuo is bound to react favorably on our relations with China when the Chinese people come to realize its real significance. Before long, the Chinese will learn that Manchuokuo means peace, order, freedom, and hope for the future. They, and ultimately the world, will find reasons to be sincerely thankful to Japan. For the time being, however, China makes a gesture of resenting the action Japan has taken in Manchuokuo. But time and actual results will surely enlighten her.

I would ask those who accuse us of imperialistic designs what particular benefit an imperialistic policy of aggression would bring to Japan. The annexation of Manchuokuo would defeat the very end we have always had in view. By annexing Manchuokuo Japan would become a direct neighbor of Russia, a situation most undesirable for the peace of the Far East and the security and welfare of the Japanese people.

Even in these days, when the Japanese army is engaged in no more than a local pacification campaign against the bandits in scattered regions of Manchuokuo, the world hears alarming rumors of an impending war between Japan and the Soviet Union. If this were the case, what would happen, one may ask, if Japan extended her territory so that it touched Russia along a frontier of over a thousand miles ? Would such a condition help the cause of peace, which Japan is so eager to promote ?

II

The Manchurian incident served to unite the Japanese nation as one man. The gravity of the situation it created in the Far East and at Geneva had a sobering effect on the political parties in Japan, which sank their differences and stood solidly behind General Araki. The circumstance misled some foreign observers into the ridiculous conclusion that the military were running amuck under Araki's dictatorship and were on the high road to establish a Fascist rule in Japan. Nothing was further from the truth.

The army under General Araki came to occupy a conspicuous position only because the development on the Asiatic mainland had absolutely necessitated it. The Chinese war lords, by wantonly trampling upon our vested rights and interests in Manchuria, threatened the very existence of our nation. They had penned us up in a desperate position where, if we did not want to perish or surrender, we had to strike in defense ; and strike we did effectively. This is the business of the soldiers. Our soldiers were called upon only to perform their duties. It happened that General Araki headed the military administration soon after the outbreak of the fighting, and this gave the false appearance that he was ruling the nation like a dictator.

In Japan, dictatorship, Fascism, or any similar system in which one man imposes a despotic will on the nation has absolutely no chance to thrive. It is not in the blood of the race to tolerate dictatorship. The moment the Japanese people are dictated to, they will oppose the dictator, whatever the consequences may be. Nobody has any chance of becoming a Fascist dictator. Whatever development may occur, General Araki, or whoever may take his place as the chief of the army, will continue to be a most loyal subject of his Majesty the Emperor, like any other Japanese.

In the short period of a little over sixty years, Japan has imported and assimilated western institutions in such great haste that she has had no time in which to make a proper selection. Almost haphazardly we have taken what came within reach, and

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Japan's Population Problem

By Professor UYEDA, from the "Daily Telegraph," London Conservative Daily

EVERY serious student of present-day Japanese life will agree that the rapid increase of the population is one of the fundamental factors underlying current events of all kinds. The subject is especially remarkable because that increase is taking place at a time when the population of the European countries has become almost stationary. The birth-rates in 1931 were :—

France	17.4	Sweden	14.8
Germany	16.0	Saxony	12.8
England	15.8	Japan	32.1

The total population of Japan counted 64,450,000 at the 1930 census, and during the last five years the annual births ranged between 2,070,000 and 2,180,000. On the other hand, the death-rate is dropping sharply, chiefly owing to the decline in infant mortality. Thus it is considered by some superficial observers that our country is combining the Oriental birth-rate and the Occidental death-rate and making the increase of number almost limitless. To us such an idea is not convincing.

The English birth-rate during the decadel 861-70 averaged 35.2. That is higher than the latest Japanese rate. Since that time it has been falling persistently, and it is now less than half the former rate. Infant mortality (deaths of infants under one year per thousand births) was 156 in 1870, 146 in 1900, and 80 in 1925. The corresponding Japanese rate was 164 in 1921, but it came down only ten years later to 132.

II

What are the facts ? First of all one must point out that the Japanese are postponing marriage, and, when they are married, they are raising fewer and fewer children. At present the number of women of reproductive age is rising every year by hundreds of thousands, but the annual number of births increases only very slowly, since it had already reached the two-million mark in 1920. This means that the birth rate is falling. If this tendency goes on for the next thirty or forty years, the population will become stationary in Japan as it has in Europe.

The crucial point of the Japanese population problem is not the infinitude of growth. It lies in the fact that the number of children is large in comparison with the whole population. Accordingly, an increasing number of children leave school every year and apply for employment.

The working population (men and women in the age groups from 15 to 59) was 30 million at the first national census in 1920. It increased to 35 million by 1930, that is, at the rate of 500,000 every year. According to a personal estimate, the same rate will last until it expands to 45 million in 1950. This is ten million above the figure of the 1930 census.

Thus, an increase of ten million persons trying to obtain employment should be expected in the coming twenty years. The country's working population, which has been growing so rapidly, is almost certain to continue its growth at the same rate for at least two decades. How to provide these people with gainful occupation is the vital problem we have to face.

Four remedies have been proposed—the development of home industries, emigration, expansion of export industries, and birth control. Of these the fourth cannot be effective, apart from the moral problems it raises, because those who want employment in the near future are already born and constitute the present child population. Agriculture, although it is still supporting 41 per cent of the whole population, cannot absorb additional workers to any great extent. The number occupied in agriculture was almost the same in 1920 as in 1930.

Up to the present we have utilized most successfully the small volcanic islands called the Japanese Archipelago. Incidentally, its population doubled in the sixty years since western civilization was introduced to the nation hitherto isolated from all outside communication. Every small patch of arable land stretching between mountain ranges is used for rice, barley, wheat, or mulberry. The Japanese villages are at present the most densely populated in the world.

For many years preceding the European War the production of rice in the country increased at a quicker rate than the growth of population. The people who used to eat barley in mixture with rice were able to take more and more rice as the principal item in their diet. But since that time the supply has had to be sought from Korea and Formosa, and, strangely enough, the farmers of Japan proper are now in severe competition with the colonies, where it was found that Japanese rice could be produced cheaper than at home. The control of the rice price has become one of the absorbing questions of the day.

The production of silk cocoons, which is the source of income of many farmers, advanced ever since the country was open to foreign trade—especially since the War and during the American prosperity period. But the outlook for the silk industry is not considered hopeful, as the technique of rayon manufacture is being improved every year. The other branches of primitive industries, such as forestry and fishing, cannot absorb a large additional population, for both are naturally minor industries and the former is meeting foreign competition.

While agriculture cannot absorb additional population, the agricultural villages are showing a much higher birth-rate than are the towns and cities. A large number of young people born and brought up in the rural areas emigrate to the urban districts seeking employment. The question arises whether the cities and towns can continue giving them employment. The national census of 1930 showed an increase of only 6.13 per cent over 1920 of gainfully occupied persons, while the total population increased by 14.48 per cent.

If, therefore, the same proportion of the people had been employed in 1930 as in 1920, there ought to have been 2,370,000 more employed. This means that so many persons seeking employment could not find it in 1930. The fact in itself is somewhat alarming.

But when we analyze this figure and find out the unemployment rate in different age groups, male and female, the situation is not so bad. It is shared by 1,040,000 females, 820,000 aged people and children, and 500,000 males between 15 and 59. Improvements in factory and mining laws would explain to some extent the heavy decline of child and female employment.

But it still admits the existence of half a million unemployed men. And, in addition, we must count the diminishing income, either in the form of wages or profits. If such is the condition of industries in relation to population during the last ten years, the prospect for the next twenty years is really a serious question, especially when we recall my estimate that the working population will continue to grow.

III

As to emigration, it is improbable that 50,000 emigrants per annum can be sent out to all the places open to the Japanese, including Manchuokuo. Although some thought that emigration to Manchuokuo would ease Japan's population problem, serious students of the subject always knew that there are many obstacles in the way of sending large numbers of people there. The restrictions on emigration to other countries are well known.

Emigration therefore cannot touch the heart of our population problem, although its development is desirable in many respects and although it is certain that any relaxation of restrictive policy on the part of foreign nations will have a good psychological effect. Thus, there is nothing but to turn to the last solution, the expansion of industrial exports, as the only method of dealing with this difficult question.

We can assume, perhaps, although exact figures are not available, that between seven and eight million people are now employed in connection with our foreign and colonial trade. If we succeed in enlarging our trade by 50 to 100 per cent within

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Japan Looms Large Before Filipinos

(The publication of an article advocating an alliance between Japan and the Philippines after independence of the islands, written by Pio Duran, Associate Professor of Mercantile Law in the University of the Philippines and a noted lawyer of Manila, proved a vertiable bombshell that stirred all strata of society in the islands. The article provoked heated discussions among the Filipino leaders, both for and against the proposed alliance. The following article that appeared in a Manila daily was undoubtedly inspired by the prevailing situation that calls for " the formation of definite and pronounced schools of thought on Japan.")

* * *

ONE of the most significant contemporary developments in the Philippines is the formation of definite and pronounced schools of thought on Japan. Japanophobes and Japanophiles are fast cutting their teeth, and fast enlisting their followers. And proof of the profound concern which the sun empire has created in Filipino minds is the apparent universality of the infection. University professors and business men, socialites and poets, one and all, feel constrained to identify themselves with the one or the other group. Discovering an attitude to Japan is the present vogue.

The why of this new phenomenon is not hard to ascertain. Its how and wherefore are harder to explain. In any event, the scramble for positions is itself an acknowledgment that Japan is the power in this part of the world. The result is a more intimate general knowledge of Japan and the Japanese.

A derelict boat allows a constabulary patrol to board it, then its crew assaults, robs and dumps the patrol into the sea. An international incident develops in which the helplessness of the Philippines is unwittingly advertised to the world. Coastguard cutters rush to the scene, simulating a British fleet's maneuver upon an enemy, but the cutters are unheard from for days, until the supposedly pursued boat bobs up in a distant Japanese territorial port. The entire picture of flight and plight, which engages the anxious attention of the Philippines, is of course pervaded by a distinct Japanese background.

A university professor in no less than a university supported by the Philippine government urges, in a series of articles sold to the most powerful section of the Japanese press, alliance between the Philippines and Japan. A professor in a government university in Tennessee who was indelicate enough to insinuate relationship between Tennesseeans and monkeys was subjected to a court trial. But we have more liberty of thought and expression in Manila than in Tennessee, although we notice with gratification that the Manila professor is bound to get as much publicity as did the professor of evolution.

Japan in Convention

A delegate to the Constitutional Convention takes the floor and, to use his own words, reveals how Japanese citizens and Japanese corporations have acquired possession of vast land areas in Davao. Even before the official stenographer of the Assembly can transcribe the speech from his notes, the Japanese consulate in Manila issues an apologia replying to the charges and not only exonerating but also praising the Japanese in Mindanao.

The Japanese consul addresses a university student body to warn against prolonging and strengthening the present economic ties with the United States and to point out that Japan is the next logical friend of the Philippines. He arouses widespread resentment. His bold ideas are cabled both to America and Japan. But while Washington keeps its counsel, Tokyo's foreign office indirectly approves them.

A weekly publication fulminates against the Japanese consul. It accuses him of meddling and of considering himself the Governor-General of Japan in the Philippines. It ridicules what it considers the consul's presumptions and insinuates that in the past consular representatives had been recalled for less.

Nippon Inescapable

Japan, both as a topic of conversation and as an imminent force in Philippine life has become inescapable. The president of the constitutional convention, speaking before the Rotary Club, states as the greatest danger to an independent Philippines " not the economic collaboration of America which we should foster and stimulate, but such other economic ascendancy, such Monroeism which in view of geographical factors will mean for us and our posterity our economic pauperism and our political extinction." All his listeners believed that he was referring to Japan's movement for an Asiatic irredenta.

With such a deep preoccupation in this country over Japan it is natural that the people themselves are talking of the Sun Empire.

" It won't be long now," a friend of mine often says, " before we shall be wearing kimonos."

" Filipinos with American clients," reasons out a young lawyer, " are at present our best-paid lawyers. It seems to me that in the near future, Japanese clients will take the place of Americans. Believe me, I am not only studying Japanese but I am also developing a Japanese clientele."

" Japan ?" inquires a politician, " why Japan is on the verge of collapse. Its people are over-taxed, its army and navy are domineering and communism is about to knock off the empire's bottom."

" And even if Japan were not face to face with an internal danger," adds another, " it is bound to find itself knocked into a cocked hat some day by Russia, China or the United States."

" Your cheap Japanese articles," a business man opines, " are symbolic of your Japanese might—no quality and no durability."

The Filipinos are discussing Japan as the members of a family would be talking of a bride or a groom which the son or the daughter of the house is about to acquire and bring home to live.

Insofar as it can be ascertained, the philosophy of the Japanophiles seems to be based on a confusion of fatalism, perspicacity and foresight. They start from the belief that Japanese influence in the Philippines will be so intense that indifference to it will be out of the question. Then they decide on the consideration that there will be less to lose and more to gain by alliance with the powerful.

In this part of the world, the Japanophiles believe, there are only two or three powers with which to reckon. These are China, Russia and Japan. But Japan licked both Russia and China in the past, so the safest bet is the Sun Empire. In their belief, the Orient, as soon as America leaves the Philippines, will inevitably become a Japanese sphere of influence. So why not befriend Japan ?

Japan, as the leading nation in Asia, will be a good friend but a bad enemy. And if Japan should want to be more than a friend and would like to have a few more Manchoukuos ?

" What of it ?" asks the university professor. " The Filipinos, I am sure, would rather see their country under the sovereignty of an Oriental nation than owe allegiance to a Western power!"

Japanophiles' Error

It seems, however, that the Japanophiles in general are not expecting actual Japanese colonization, though they are also prepared for it just in case. But even so, their position appears to be especially vulnerable in that they either consider, like the young lawyer, material benefit as paramount, or take for granted that some one nation must always be dominant in Philippine affairs.

There seems to be no questioning the logical fact that Japan will replace America in its premier position in Philippine commerce unless the much-desired trade reciprocity between the Philippines and the United States can be consummated. There is no doubt whatever that, if American exports to the Islands and Philippine exports to the United States have to be curtailed because no reciprocity arrangement is possible, the big American importing and exporting houses and agencies in the Philippines will eventually give way to Japanese successors.

If, after developing the Philippine market to its present wealth and after uncovering its still greater potentiality, America wills this market to Japan, then Japan must also fall heir to the commercial, professional and social preferences which America now enjoys in the Philippines.

The Japanophiles are thus foresighted but they are victims of over-developed perspicacity. The American Congress, as Horace B. Pond has pointed out, has left the door open to veritable perpetual commercial reciprocity between the Philippines and the United States. Japan therefore may never gain the commercial ascendancy in the Islands which the Japanophiles prematurely consider consummated.

Japanophiles' Complex

It is also evident that the Japanophiles are laboring under a submission complex which is perhaps natural to a race which has been under foreign control for four centuries. As an independent nation presumably trained in American diplomacy, the Philippines is expected to cultivate an unhampered foreign policy on the basis of Washington's wise admonition to contract no entangling international alliances. The readiness to acknowledge Japanese leadership in the Orient springs from an unfortunate subject complex and renders abortive a sane and fair international policy. Russia and China to the North and Siam and the other countries to the South are as worthy as is Japan of friendship and admiration.

And yet, it is as easy to run to the extreme in fearing and even hating Japan, hence our Japanophobes. To them, Japan is a nation to guard against because of its might and its unscrupulousness. In their eyes, Japan is a mysterious nation with evil designs and ambitious aspirations. They suspect Japan and, suspecting it, they also fear and hate it.

Japanophobes' Case

They indict Japan on its well known record in Taiwan, Chosen and Manchuria and point to the Japanese dominance in Davao and control of the dry-goods stores of the country as samples that are right under our very noses of Japanese insidiousness.

The Japanophobes' error consist in their disregard of the good qualities that are Japan's, and in their failure to relate the present desperate foreign policy of Japan to its more remote and more extensive history in relation to other nations. In fact, as late as 10 years ago, students of international affairs were quite unanimous in pronouncing the verdict that Japan was most trustworthy and most scrupulous in its fulfilment of the requirements of international treaties and obligations.

It may be said, of course, that the past cannot exonerate the present, that the present is a better indication of the future than antiquity. But it can still be said that the developments of a decade can hardly indicate a permanent national tendency. Indeed, the more penetrating observers of Japanese affairs are of the belief that the present abnormal conditions of Japanese internal affairs, in which the old-school militarists are predominant, are mainly responsible for the current international excesses of Japan. That these conditions will not last is their well-considered conclusion.

There was a time when mention of Japan's asserted capacity only elicited shoulder-shrugs here. For decades, observers of the movement for independence and of Japan's international awakening have been warning us, sincerely or maliciously, against Japan. But we did not mind the warning. Japan, we said, was no danger to an independent Philippines. In some mystical way, we felt sure that Japan would do right by us.

Sobering Temper

The sudden rise of Japanophobes is therefore somewhat strange. Even this, however, is explainable. Boldness is the essence of aspiration. When we were demanding independence, we were in effect clamoring for a chance to meet and surmount all the obstacles of which the prophets of dire happenings spoke. We ignored the road and its fatal roughness; we only saw the goal. Now, however, that the goal is certain, our attention is more closely drawn to the how of attaining it. And we see the obstacles as we have never seen them before.

Thus Japan looms big and forbidding. But the novelty and the strangeness will wear off. For, in reality, Japan is a nation worth admiring. While it may have its ambitions—and what strong nation has no ambitions—it has the proper sense of international amity and responsibility. If only for the purpose of disillusioning the Japanophobes, the Japanese government should surrender the crew of the *Haiun Maru* for trial in Philippine courts. Japan, because of the incident, has in its hands the unique opportunity of demonstrating to the Filipinos, not assertion of might, but respect for equities.

All to the Good

This scramble to adopt attitudes on Japan is probably all to the good. For we are an Oriental people whose attention the West, by force, has monopolized. We do not know the Orient—our own Orient. We know only America and Europe. In our schools, the histories of the West are carefully taught, but those of Japan, China, Russia, Siam, and other neighboring countries are largely ignored. While some of our universities are teaching courses in French, German and other foreign languages, not one has so far paid adequate attention to the study of Oriental languages. As a consequence, our people judge our neighbors on surface information and casual impressions.

The upshot of all the current interest in Japan will be the definition of a national attitude that will be fair and sane, not only to Japan but also to the rest of the world. Out of extremes, the world fashions the more workable systems, schemes, rules and norms. Some day, we shall yet know Japan better.

Realities in the Far East

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of government which date back some centuries before Europe had begun to think about emerging from barbarism, possesses knowledge of statesmanship which is ample for its needs. What it wants is a field cleared of the debris left over from the Revolution, an assurance of national security, and the willing and disinterested help of its friends and neighbors. That help it should be our desire and resolve to give. We have done some good work for China in the past, and a not inconsiderable amount of mischief, both by our strength and our weakness: and our past connections have not been unprofitable. Now, with no thought of direct gain, let us try to add to our credit, and wipe out the record on the other side, by assisting China to secure those conditions which are essential if she is to establish a stable and efficient government.

While the sun rises daily upon suspicion, unrest, and disorder its beams can bring no blessing to the world.

The Coming Struggle for Sea Power

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How, then, are the prospects to be summarized? Frankly, they are black. With the possible and dubious exception of Great Britain and the United States, all the powers are at sixes and sevens in respect of naval policy. However much British statesmen may wish to work in accord with the United States, they are bound to consider, in the first place, the balance of power in European waters, and this, as it happens, is just that aspect of the general problem in which the United States is least interested. The situation in the Pacific is comparatively simple and, given a modicum of goodwill all round, it should be no difficult matter to determine, either roughly or precisely, the future dimensions of the navies of the three powers chiefly interested. A combined Anglo-American front at the council table would probably induce a reasonable frame of mind in the Japanese delegates, who, being men of sense, would know that neither Great Britain nor America harbored designs against the peace of the Far East.

But tied fast to the leg of British statesmanship is the ball and chain of potential, if not actual, menace in the North Sea, the Channel and the Mediterranean. To invite Great Britain to sign a disarmament pact based on Pacific strategy alone would be tantamount to asking the United States to frame its future naval policy without the slightest reference to Caribbean or South American waters or, indeed, the Atlantic as a whole.

The track of the 1935 naval conference bristles with danger signals which cannot be ignored without courting disaster. It will be held in an atmosphere highly charged with electricity. No swift success need be anticipated. A previous alignment of British and American views on the Rapidan principle will not avail this time and would probably do more harm than good. Japan, France and Italy are one and all in a suspicious and very touchy mood on the subject of armaments. If the conference is to avoid shipwreck, its course must be steered with consummate finesse. This time the rule-of-thumb navigation methods which proved effective at Washington in 1921-22 and at London in 1930 will be of no avail.

What Interests America Most

By JAMES A. RABBITT

(The following is an address that was delivered by Mr. Rabbitt before the Pan-Pacific Club in Tokyo shortly after his return to Japan from a tour on which he visited Europe, the United States and Canada. Mr. Rabbitt was formerly Commercial Attaché of the American Embassy in Tokyo and is now technical advisor to the Japan Nickel Information Bureau and Editor-in-Chief of the "Japan Nickel Review").

* * *

THE questions about Japan which were usually put to me while on my trip to America and Europe this summer were (1) Will there be war between Japan and China? (2) Will there be war between Japan and Russia? and (3) Will there be war between Japan and the United States?

To one accustomed to think of things Japanese in terms of specific problems such as the purchase of the North Manchuria Railway, or the suppression of banditry in Manchuria, or how the Finance Minister will balance the budget, these broad general questions are as perplexing as a child's query: "How far is it to Heaven?"

Yet these questions are in themselves instructive, as they indicate that the Americans and Europeans are no longer interested in the so-called Manchurian question, or other issues which were looked upon as vital two years ago.

There seems to be indicated by these questions a vague sense of insecurity regarding the Far East, which may be the result of Japan's retirement from the League of Nations. Everywhere in Europe there seems to be this same sense of insecurity resulting from the withdrawal of Germany from the League.

In the United States, however, the interest in Japan, Manchuria, China, or Europe was everywhere eclipsed by the vital interest which the people are taking in the outcome of their own "New Deal."

I did not hear any talk of "depression," but there were doubts expressed on all sides as to the probability of the application of the "New Deal" becoming a hindrance to permanent recovery, due to the burdensome restrictions which it places upon private initiative and enterprise. In fact, wherever I visited on my trip East and again in crossing the country from East to West, stopping at Washington, D.C., and making stops in Virginia, West Virginia, Ohio, Michigan, Illinois and the State of Washington, the question was always: "What do you think of our 'New Deal?'" And when I reversed the question the answer was usually the same: "We don't know where it will lead to."

America has been a land of opportunity for the individual, a land where individual initiative and enterprise became a form of national expression. Therefore, price fixing and the multifarious other restrictions which are applied under the "New Deal" are foreign to the American spirit, upon which the vast industries of the country have been built.

The questions, therefore, are very vital ones: Will Americans change their mental processes and become pawns in an elaborate system of state socialism, where every industrial activity is weighted down by restrictive regulations, and the prices of all commodities and labor are fixed by federal agents instead of by the law of supply and demand? or: Will the "New Deal" be modified to suit the American people?

Aspect Changes

When first applied, the "New Deal" was supposed to have been merely a temporary measure, as the "priming of a pump," to use one of its proponents' slogans. With time, however, there has been built up an elaborate machinery of governmental control which has given employment and power to thousands of political favorites whose very existence depends upon the continuation of "New Deal" methods and machinery, regardless of its desirability to the old and seasoned industrialists, or to the skilled worker who did well under the old régime.

While the inauguration of the N.R.A. was primarily to prevent ruinous competition in the old order of *laissez faire*, it has in some instances actually been used as a medium of such competition, a specific example being that of the mattress manufacturers of West Virginia, who were practically forced to shut down their plants because of the direct participation by the federal government in the production of mattresses to be given away to the so-called needy.

The reason many industrialists find codes to work a hardship on their own particular industry is that in making up a code for one particular class of business it cannot be comprehensive enough to suit plants of all sizes and localities. The fact that one government official is credited with having drawn up over one hundred codes also makes one wonder if it would be possible for any individual to accumulate sufficiently profound knowledge regarding one hundred industries to draw up adequate codes.

There are at present cases on record where industrialists are trying to comply with codes so impractical as to make their existence impossible. Relief cannot be gained as regards hours or wages, so they have attempted to cut their overhead by moving to localities where they could comply with the code and survive. This effort is being blocked by injunctions and threatened laws to prevent the removal of established industries.

These specific cases affecting industrialists in reality affect labor also, and this makes the "New Deal" unpopular with the two main elements in the economic life of the nation. Labor is beginning to realize that the power vested in the N.R.A. which has arbitrarily (in many cases) fixed a high minimum wage and short hours, might easily be used, if applied by heads unsympathetic to labor, for the arbitrary reduction of wages and increase in hours. Labor has also been forced to pay arbitrarily higher prices for the commodities of subsistence, thus offsetting higher minimum wages.

The N.R.A. was planned to be the means of putting millions to work, but there have been cases where plants have been prevented from operating because they could not afford to pay the minimum code wage. As an example, capital and labor tried to work out their salvation in the case of a hand-operated stone quarry at Danville, Illinois. The plant was too small to exist under the stone quarry code, and application was made to the N.R.A. over the signatures of both employers and employees, that operation be permitted at a stated wage agreeable to all concerned. Indefinite government red tape and delays finally killed the project, and put the applicants on the government charity relief rolls.

These remarks are not intended as a barrage of pessimism, but these are phases of the problem which indicate the gravity of the situation, and which must be faced squarely and honestly.

Distinct Feature

There is one feature of the N.R.A. which I think is a distinct although not immediately productive advantage to the people of the United States, and that is its creation of a political consciousness among all classes. The front pages, and much of the inside pages of the daily press, are now devoted to reports or controversies on the practical or impractical applications of the "New Deal."

Such economic questions affect everybody from bankers to bootblacks, and from clubwomen to housemaids, and the realization of the application to themselves of these questions, through the medium of the daily press, is awakening the American people from their long political lethargy which was the result of more than a century of economic progress. I have not seen any comments on this phase of the N.R.A., but from my perspective as a non-resident American I can see in it the one definite advantage to my countrymen which may in the long run mean more to national integrity than any wave of prosperity, real or imaginary.

Party Lines Fluctuate

This political consciousness, based upon the vital economic issues of to-day, is disintegrating the old political parties, and as a

(Continued on page 510)

Water Supply in Hongkong

The Story of a Triumph of Applied Science

By Professor C. A. MIDDLETON SMITH, M.Sc., M.I.Mech.E. (Dean of the Faculty of Engineering in the University of Hongkong)

PART V.—THE NEW RESERVOIR AT SHING MUN

In earlier articles on the Hongkong water supply system it was explained that the Shing Mun Valley had supplied water to Kowloon since 1926; later the harbor pipe line connected Shing Mun Valley with the Hongkong island distribution system.

The object of this contribution is to describe, in some detail, the work that has been done, and which has been planned, in connection with the creation of the enormous reservoir in the Shing Mun Valley.

The preliminary report on the Shing Mun scheme, made by Mr. R. M. Henderson, the Hongkong P.W.D. Waterworks Engineer, in 1924, suggested as a possibility of finally utilizing the large catchment area available, as many as nine reservoirs varying in capacity from 55 million gallons to 1,700 million gallons, with a total storage capacity of about 4,500 million gallons.

The scheme then outlined was estimated to give a daily supply of 17 million gallons per day during the driest known period.

There were six sections to the scheme but rough estimates were prepared only for four sections as the other two were considered very problematical. The four sections included a reception reservoir and eight reservoirs (with dams) impounding the following quantities of water in millions of gallons viz (1) 900 (2) 900 (3) 185 (4) 200 (5) 137 (6) 400 (7) 1,700 (8) from 2,000 to 3,000. The grand total of the eight reservoirs would be about 7,000 million gallons, but (8) was not included in the above estimate of 4,500 million gallons.

W. J. E. Binnie, M.A., M.INST.C.E.

G. B. Gifford Hull, O.B.E. M.INST.C.E.

Most of these reservoirs were to have gravity feed, but some were at such a low level as to necessitate pumping stations.

The gravity sections were roughly estimated (in 1924) to cost approximately $10,250,000 and the low level sections $6,500,000.

The Secretary of State for the Colonies, in London, on receipt of this extensive Report, decided that in view of the magnitude of the scheme, London Consulting Engineers should be engaged to advise the Hongkong Government and himself on the matter.

This was done with the result that arrangements were made that the Consulting Engineers should consider the original proposals, and later they were requested to design and supervise the work of the building of one reservoir at Shing Mun.

It was finally decided to make a gravity feed reservoir of greater capacity than was estimated for two of those suggested in 1924. That meant building a dam higher than had been proposed for any reservoir in the original scheme.

The Hongkong Public Works engineers gave all the help requested during the reporting stage of the work; their rainfall figures were valuable as a guide.

As explained in Part IV of this contribution some of the work proposed by Mr. Henderson was put in hand soon after his proposals had been submitted.

This section will deal only with the Shing Mun reservoir, now in course of formation.

Rapid Progress

We may say that work on the site for that reservoir was commenced at the end of 1932. It is astonishing to see what has since been accomplished.

Modern buildings have almost suddenly appeared in many places. A water supply system, electric power, sanitation, a new road, and a partially constructed dam have been built. A village in a valley is to be submerged and the villagers have been sent elsewhere to newly built cottages—after much protest. The quiet of centuries on the hills has been broken by the rattle of modern machinery. Shing Mun Valley has been transformed.

The Resident engineer responsible for these innovations is Mr. Gifford Hull, M.INST.C.E., who arrived in Hongkong in November, 1932. He represents the London firm of Consulting Engineers, Messrs. Binnie, Deacon and Gourley who, after many preliminary investigations, designed the huge, and very remarkable, dam that is now in the course of construction. It will, it is confidently believed, be completed in 1937.

Mr. Hull has during the past 26 years been engaged on about 20 dams in various parts of the world and responsible, either as designer or builder, for the last 16 or so. He recently completed the new Singapore waterworks (also designed by Messrs Binnie, Deacon and Gourlay) which cost £2½ million and which included four dams in Johore.

With that long experience of dam construction and the difficulties connected with labor in a tropical climate (including the danger to health of malaria, etc.) to enable him to solve the local problems, the Resident Engineer soon made things move at Shing Mun.

On several occasions the writer has visited the Shing Mun Valley with Mr. Hull. This opportunity is taken to acknowledge the patience, and the great courtesy, which he has so often shown while explaining the details of the work connected with this scheme. Every stick and stone in the Valley seems to have come under the scrutiny of the man responsible, not only for the construction of the dam, but for the health and well-being of the many hundreds of workers concerned in it.

It is not surprising that many people interested in Public Health matters have applied for permission to see this remarkable example

Fig. 1—Some of the European-Style Bungalows for Engineers, Medical Officer and others at Shing Mun

of the work of the Civil Engineer. Practically all of the principal residents of Hongkong have seen the work in progress. Recently the Mayor and other officials of the city of Canton visited Shing Mun. A number of Chinese students from the Hongkong University have seen varying stages of the scheme. The visitors to Shing Mun have appreciated the clear and interesting explanations of the details of the work which the Resident Engineer has given to them.

Time is Money

An engineer, with extensive and varied experience in many parts of the world, and an expert on dam construction Mr. Hull, has great powers of concentration. The Shing Mun dam is, as it were, the child of his thoughts; like any parent he will tell to those interested the story of the growth of the sturdy infant and explain his hopes and plans for its future. No narrow-minded technician, but a man of wide outlook, it is evident to the casual visitor that, despite his broad knowledge of affairs in general, his work is always present in his active mind. And so he will leave in Hongkong a lasting monument to remind us of his skill.

He completed the Singapore water supply scheme ten months ahead of time: he is unlikely to be behind the time estimated for the construction of the Shing Mun Dam. For that is what he values so much—the time factor in engineering contracts and especially in dam construction.

In a recent address to the engineering students of the University of Hongkong, concerning the Shing Mun Dam, Mr. Hull laid a great emphasis upon the importance of time in a big engineering work of that description. That aspect to the problem will be discussed more fully later, but it should be kept in mind always. Time is saved by careful planning ahead and the use of machinery.

The Preliminary Work

In connection with the building of a huge dam of this sort there were in addition to the dam itself, many other works had to be undertaken, in order to facilitate construction. Much planning and other preliminary work concerning the selection of the site was done before the dam construction was commenced.

There was, for example, the access road from the main Kowloon Castle-Peak road to the dam. This road is in two parts, the first of which was constructed some years ago (1924), when the first efforts were made to carry water from Shing Mun Valley to Kowloon. The road recently had to be adapted to the much heavier traffic anticipated for carrying materials to the big dam. This was arranged by planning to carry the traffic on two concrete tracks, spaced at centers to accommodate the widths of wheel tracks, varying from those of heavy lorries to motor-cars; and it was also decided to introduce a one way traffic system.

The second, or new part of the road, necessitated heavy cuttings and embankments. Finally an eight inch surface of concrete was applied. The total length of the access road from the main road (at Tsun Wan Village) to the dam site is about three miles.

Various Buildings Erected

In all some forty separate buildings were erected at Shing Mun nearly all of them in the vicinity of the dam site. Eleven of these are bungalows for the engineers, the resident medical officer, quarters for overseers, etc. (Fig. 1). The cost of these structures (which are not for temporary use and are of cheap concrete block and not timber) seems to have been very low. Thus the bungalow of the chief Assistant Resident Engineer cost about $8,300 (Hongkong currency). It consists of two good sized living rooms, two bedrooms, bathrooms, kitchen, pantry and servants' quarters. Since this type of construction is able to resist typhoon weather, the buildings will be available as residences long after the work on the dam is complete.

Incidentally it may be mentioned that the position of these bungalows makes them very desirable as residences. They are about 650-ft. above sea level, in glorious scenery and, when the work on the reservoir is completed, will be quiet, in rural surroundings, but easily accessible from Kowloon.

Mr. Hull must be congratulated upon the value obtained for the comparatively small expenditure on these buildings. Indeed, he seems, by his enterprise and practical demonstration, to have held out to many of us a hope for a reduction in the cost of residences in Hongkong.

The General Office, and Works Office, for this scheme, is at Hung Hon, in Kowloon. It would have meant building additional living quarters at Shing Mun to accommodate accounting staff, draughtsmen, surveyors, etc., and it was decided that Hung Hom is more convenient in other respects.

By January, 1933, temporary accommodation, at Shing Mun, provided by the construction of matshed lines, was arranged for 300 men. These were a sort of an advance guard of the main body of workers employed as soon as active construction on the dam commenced.

Permanent coolie lines were then put in hand (Fig. 2). These are well-built, screened and of timber, for the sleeping and living rooms, but concrete blocks for bathrooms and latrines and kitchens. There is now accommodation for about 1,500 men, with filtered water supply, water-borne sewage system, septic tanks and filters. There is a sanitary squad which collects the rubbish from tins and incinerates it. There is also a hospital of 18 beds and a resident doctor. Great attention has been paid to the health conditions of all residents at Shing Mun.

The Health Campaign

At first there was a considerable amount of sickness—when the Access Road was in the course of construction the daily

casualties from malaria at time reached 12 per cent of the total force employed; but recent average casual-ties have been only about one per cent; an astonishing reduction.

The anti-malarial work was carried out by the engineers under advice furnished by the Director of Medical and Sanitary Services, the officer of the Hongkong Government responsible for Public Health matters. The results are as astonishing as they are encouraging to those who advocate anti-malarial schemes for Hongkong. Both Mr. Hull and Dr. Wellington in previous years, had considerable experience on anti-malarial work in Malaya: we may be sure that the residents of Shing Mun have benefitted very greatly from their scientific knowledge and firm determination to fight the dread enemy of Southern China, malaria.

The results of the health campaign have been most successful. Over 860 acres of the district have been anti-malarialy treated and over 20 miles of concrete channels and seepage pipes have been laid to carry away rain water and so to prevent breeding places for mosquitoes.

Of course the disease has not been eliminated, and possibly never will be, from Shing Mun. Mosquitoes are carried into the Camp by the breeze blowing them from Tsun Wan Village. A recent visit by the writer to that village made him hope that money will be granted by the local Government to clean it up, for it does appear to be in an insanitary condition. There is no keener advocate of such reformation, in Hongkong, than Dr. Wellington, but like many a public servant enthusiastic for progress, he finds his good works limited by the money granted annually by the local Government. To eliminate disease you must provide money.

Fig 2.—One of the Three Coolie Camps at Shing Mun. The European Bungalows are shown at top of the picture

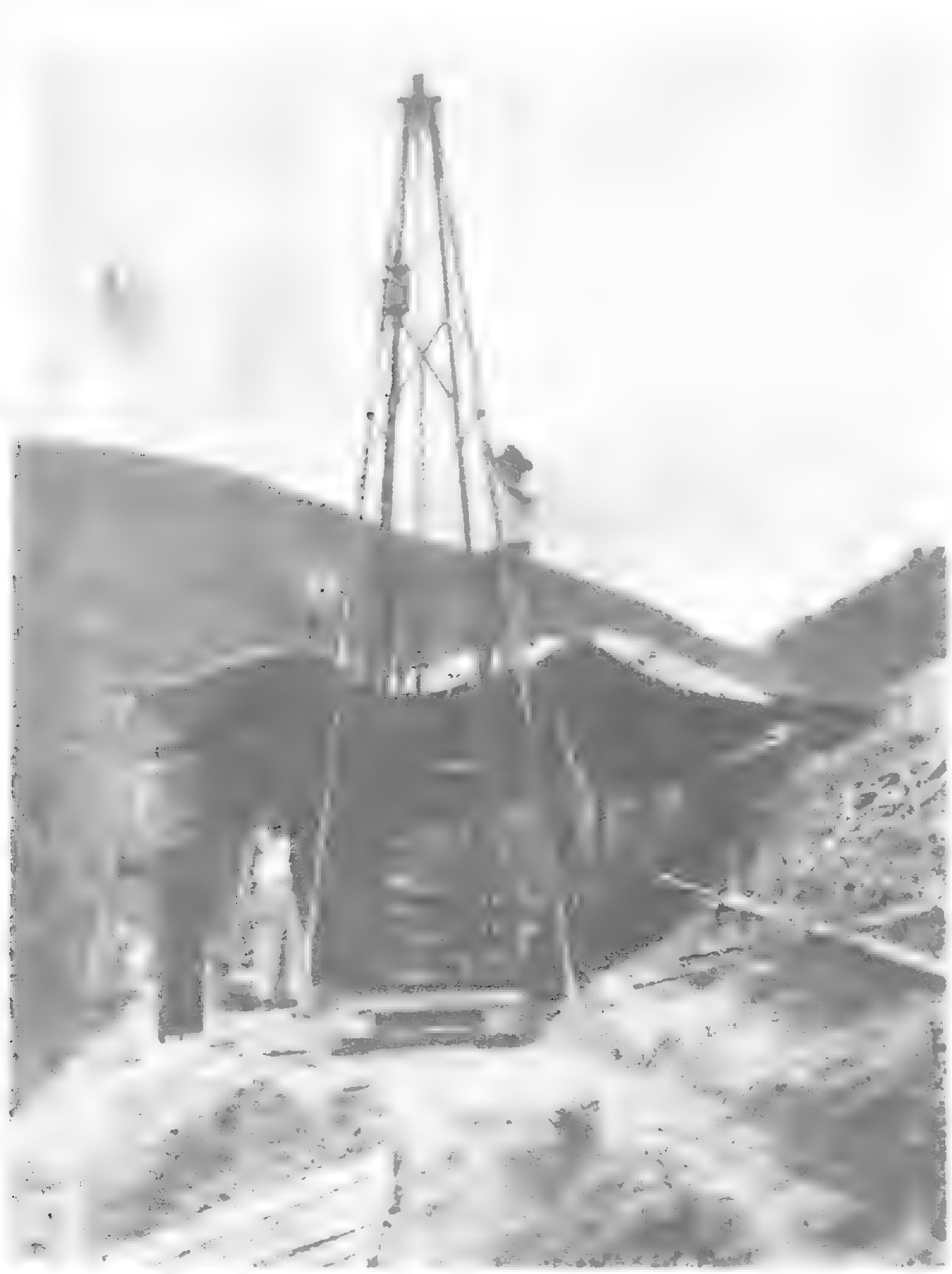

Fig. 3.—The Bore Hole Rig, showing the general operation of making trial borings to ascertain the nature of ground below surface at Shing Mun

Malaria is not the only foe to health. Precautions have been taken against all of the usual intestinal troubles—cholera, dysentry, etc., at Shing Mun. Epidemics spread rapidly when a large body of men are living together and every effort had been made to ward off sickness.

Water and Electricity

As the main purpose of the Shing Mun scheme is to ensure an adequate supply of pure water to Hongkong and Kowloon, it is not surprising that great precautions were taken to obtain pure water for the workers at Shing Mun.

Before the buildings were erected an intake was constructed in the Shing Mun river. This is below the level of the dwellings, and from the intake is pumped all the water needed for domestic purposes and use on the works. A small dam was built across the stream and, from a concrete wet well, water is pumped through a head of 265 feet to a covered, reinforced concrete reservoir of 30,000 gallons capacity, whence it falls by gravity to the supply system. There are three separate mains for domestic supply and a "Candy" mechanical filter is in use in each main. The works supply main is separate to those for domestic supply.

The pumping station is a concrete building with two electric motors (16 h.p. each) driving Worthington Triplex pumps. A 22 h.p. Campbell oil engine, operated before electric power was available, is a useful standby.

Electricity Supply

The China Light and Power Company supply electricity to Kowloon and the New Territories. They had a 22,000-volt transmission line running right across the site. The Consulting Engineers for the Shing Mun Scheme, doubtless influenced to some extent by a desire to support local industries, decided that the plant used on the works should be driven by electric power. The high tension is transformed at a works' station to low tension supply for operating motors, etc.

The cost—per unit of electricity at the works—varies from 4.8 cents to four cents depending on the amount consumed.

While it is admitted that there are many advantages of electric over steam power, on this class of work, yet many engineers still prefer the old style of steam driven winches. At Shing Mun the locomotives travelling cranes and two derricks are steam driven.

Local conditions affect the relative advantages of steam and electricity on a work of this nature. Primarily it is a matter of working cost. How much is electricity a unit and how much is coal a ton?

In this case a high tension electric transmission line passed almost over the site. And suitable terms for supply were agreed upon.

Drills and Crushers

Two rotary shot drills were put to work in January, 1933, for exploratory drilling, so as determine the most suitable site for the dam. Altogether 73 holes, totalling 2,600 feet in depth, drilled with shot and percussion drills before the site was finally chosen. Fig 3 shows a drill at work.

The drilling plant consists of air compressor, for compressed air drills. The total h.p. required for the compressors (Fig. 4) is 375. There is also stone crushing machinery and the concrete mixing plant (Fig. 5). In addition there are two five ton cable-ways, the three concrete skips, and the 52 stone skips—each capacity five tons; and derricks and cranes (Fig. 6); also locomotives, rails and wagons. There were purchased also pumps, fitting shop plant, lorries and miscellaneous gear. The total cost of the mechanical and electrical plant for the dam was about $800,000 (Hongkong currency). The cost might have been more, for not all of it was new, some having been used on the recently completed Singapore works. The plant probably will realize a useful sum if sold after the work is finished.

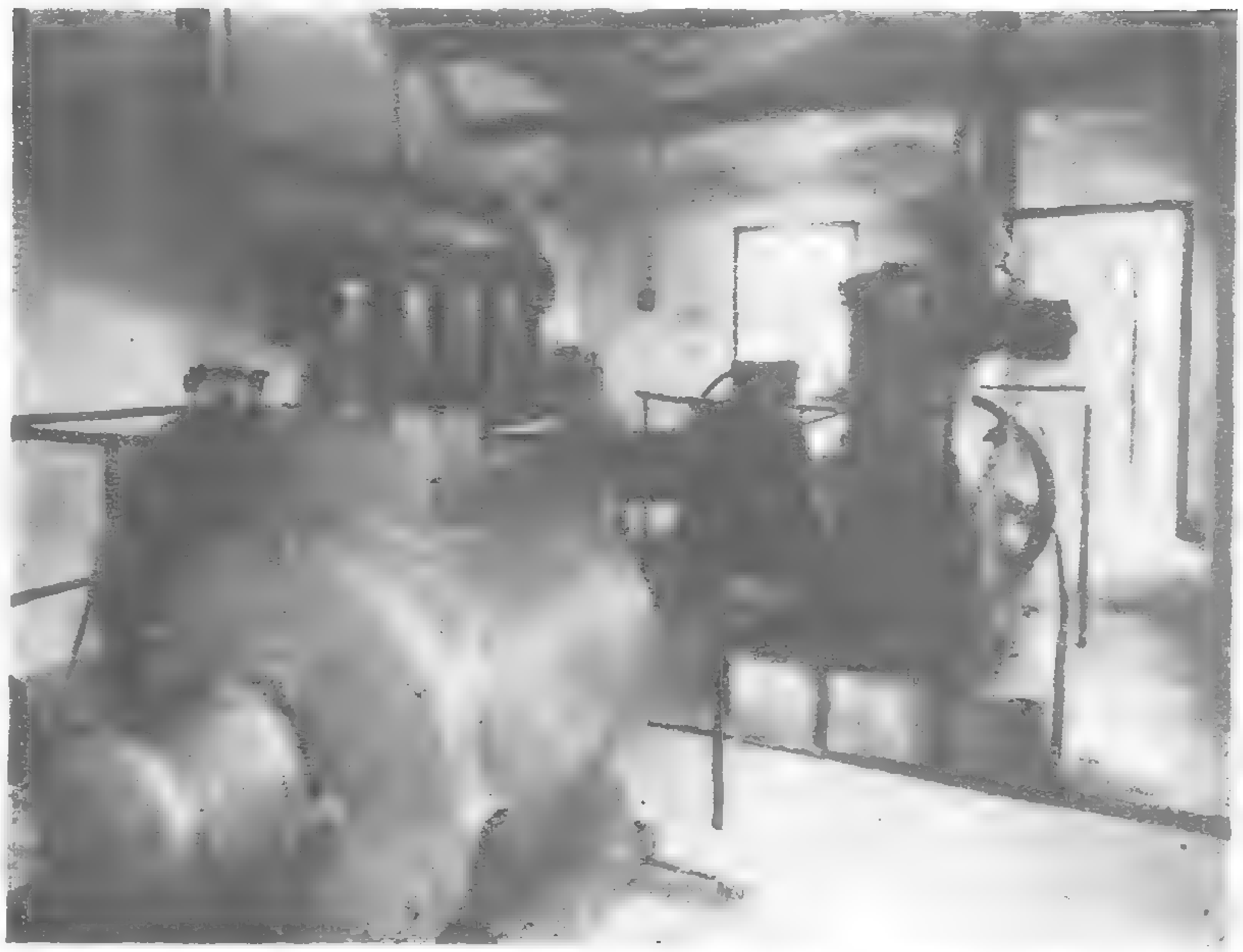

Fig. 4.—The Compressor Plant. A feature of the work at Shing Mun is the use of Compressed Air

The Supply of Cement

A great deal of publicity has been given to the problems connected with cement supply for this dam. Questions were asked in the British Parliament. The issue discussed was the choice between cement imported from Japan and the local product. As it was estimated that about 70,000 tons of cement would be required at Shing Mun it will be realized that the contract was an important one.

The conscientious engineer is not affected by political issues. His duty is to place before his clients facts. Concerning cement on this work, the only two facts that concerned the engineer were the quality of the cement and the price.

At the time just before the contract was placed there was a great deal of excitement on account of political and economic difficulties that had nothing to do with the two facts mentioned above. Rightly, or wrongly, certain British politicians were alarmed by the competition in manufactured goods exported from Japan; and we may be quite sure that the shareholders in the cement works situated in Hongkong were determined to use the cry "support local industries" in order to secure this contract.

Let us now return to facts. Having tested a large number of samples of Japanese cement, the writer is convinced that cement can be made in that country to conform to all of the requirements of the British Standard Specification for cement; and the same can be said of the Hongkong cement. From the technical aspect, as to quality, there seems to have been practically nothing to choose between the two rival cements. There remained, then, only the question of cost.

At first there was a very great difference in the tenders for cement. And it then became a question as to whether the difference was too great to permit of the use of the local product.

All sorts of arguments, mostly irrelevant, were advanced on that subject. The Hongkong Government (*i.e.* the taxpayer in Hongkong) had to pay the bill for any cement used at Shing Mun. It was said that 1,500 men would be employed in Hongkong, for quite a long time, if the cement were made locally. And would the local community benefit from that extra employment (and wages) enough to make up for the difference in price?

Finally, the ingenuity of the engineer solved a problem that was causing a great deal of local controversy. He evolved a scheme to carry the Hongkong cement in bulk from the works. That eliminated sacks—costly and wasteful—and saved the expenditure on a large cement shed at the works, necessary for imported cement.

A satisfactory method of loading bulk cement into steel containers placed in lighters at the wharf of the local cement works was evolved. And arrangements were made for water transport to Tsun Wan wharf, Fig. 7 where the five ton containers were placed, one on each lorry fitted for the purpose, and the plans included the unloading of containers at the works so as to tip the bulk cement from them into a silo over the concrete mixers (Fig. 8).

As a result of all these novel arrangements by the Resident Engineer, and a statement of the cost of each stage, it was decided to use local cement for the first year's supply. Experience has proved that this method of handling cement in bulk and with practically no manhandling is most satisfactory. The detailed arrangements were ingenious and must have been the result of a great deal of thought, by the designer.

The Tsun Wan Wharf

It was obvious that, for unloading machinery and other gear required on the site, the wharves in Kowloon were unsuitable, as they were so far away from the site and being situated on valuable land involved high rents. Finally a wharf in the vicinity of Tsun Wan was decided upon—that eliminated eight miles of road transport.

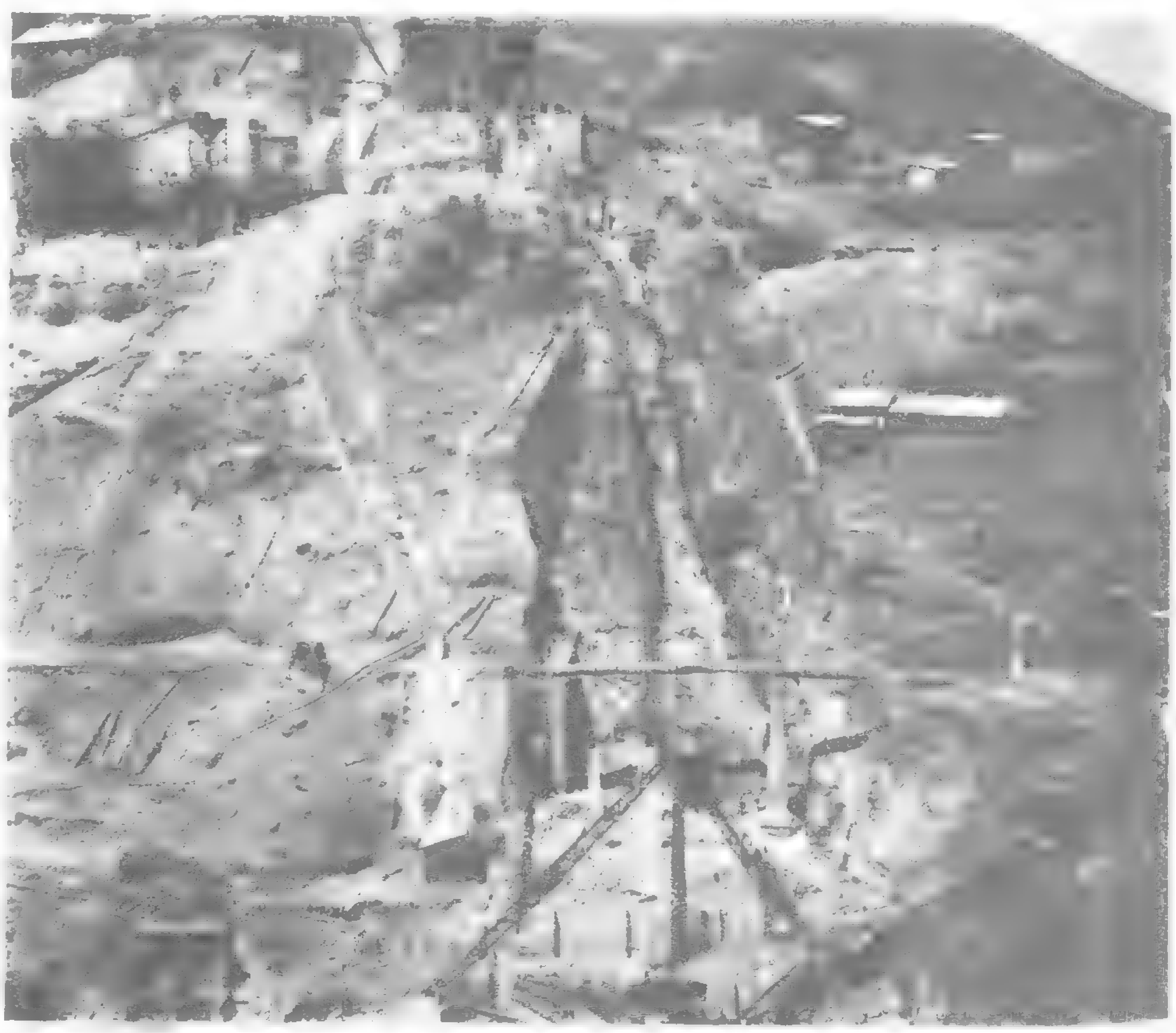

Fig. 5.—Placing Concrete in Thrust Block of South Bank of Gorge at Shing Mun

Fig. 6.—Derricks for placing Rock Fill

Fig. 8.—Cement Handling Derrick

An arrangement was entered into with the Texaco Oil Company to rent a part of their well constructed waterside depot near Tsun Wan. An unloading jetty was built there. A jetty was completed in May, 1933. The road from the depot to the Castle Peak Road—about a mile long—was re-surfaced to carry the heavy traffic.

The Consulting Engineers

As already mentioned, Messrs. Binnie. Deacon and Gourley, of London. are the Consulting Engineers appointed by the Hongkong Government to design and be responsible for the construction of the dam. The firm has earned a high reputation for work of that kind. The original founder of the firm. the late Sir Alexander Binnie, was a President of the oldest, and most famous, technical society in the world, the Institution of Civil Engineers of Great Britain. His son has taken his place as a Partner in the firm; and his grandson is at work as an assistant engineer at Shing Mun.

The two main problems that this firm of Consulting Engineers had to decide were (1) the site for the dam and (2) the design of the dam. And of course they had to keep forefront in mind the questions of cost and the time likely to be taken in the construction of the dam.

Following a study of the results obtained by the extensive drilling which had been carried out, the engineers made their decision as to site and type of dam in July, 1933, and the Resident Engineer was then to go ahead with the choice of sites, etc., for all of the plant to be used, and to make arrangements for pressing forward with the work. In the meantime the engineering staff at Shing Mun had been busily employed on preliminary work.

It would have been possible to have issued specifications and called for tenders for the construction of the dam. No Chinese firm of contractors would have been able to offer their services on account of lack of experience, and as there are several disadvantages which arise from employing foreign contractors on work of this kind, it was decided that all of the work should be carried out by the Resident Engineer and his staff, advised by the London Consulting Engineers on any problems which he might submit.

Portions of the work are let out to contract where feasible, but a great deal of it is done by wage labor, directed by the engineering staff on the site. It is noticeable that some of the gangs of workers are from North China.

Fig. 7.—Unloading Derrick at Tsun Wan Wharf. All the materials for Shing Mun are delivered here by water

The Shing Mun Gorge

For centuries what is called the Shing Mun river drained an enormous catchment area that included the slopes of Tai Mo Shan—a mountain 3,000 feet in height. Although in the dry season of the year, there seems to be very little water in the gorge, at certain periods there is a huge volume. The varying rainfall in the district varies the size of the stream, which drains such a large area that an inch of rain gives a big, and almost sudden, increase in the volume of water in the gorge.

During the dry season only a tiny trickle seems to run through the gorge, although measurements made during the

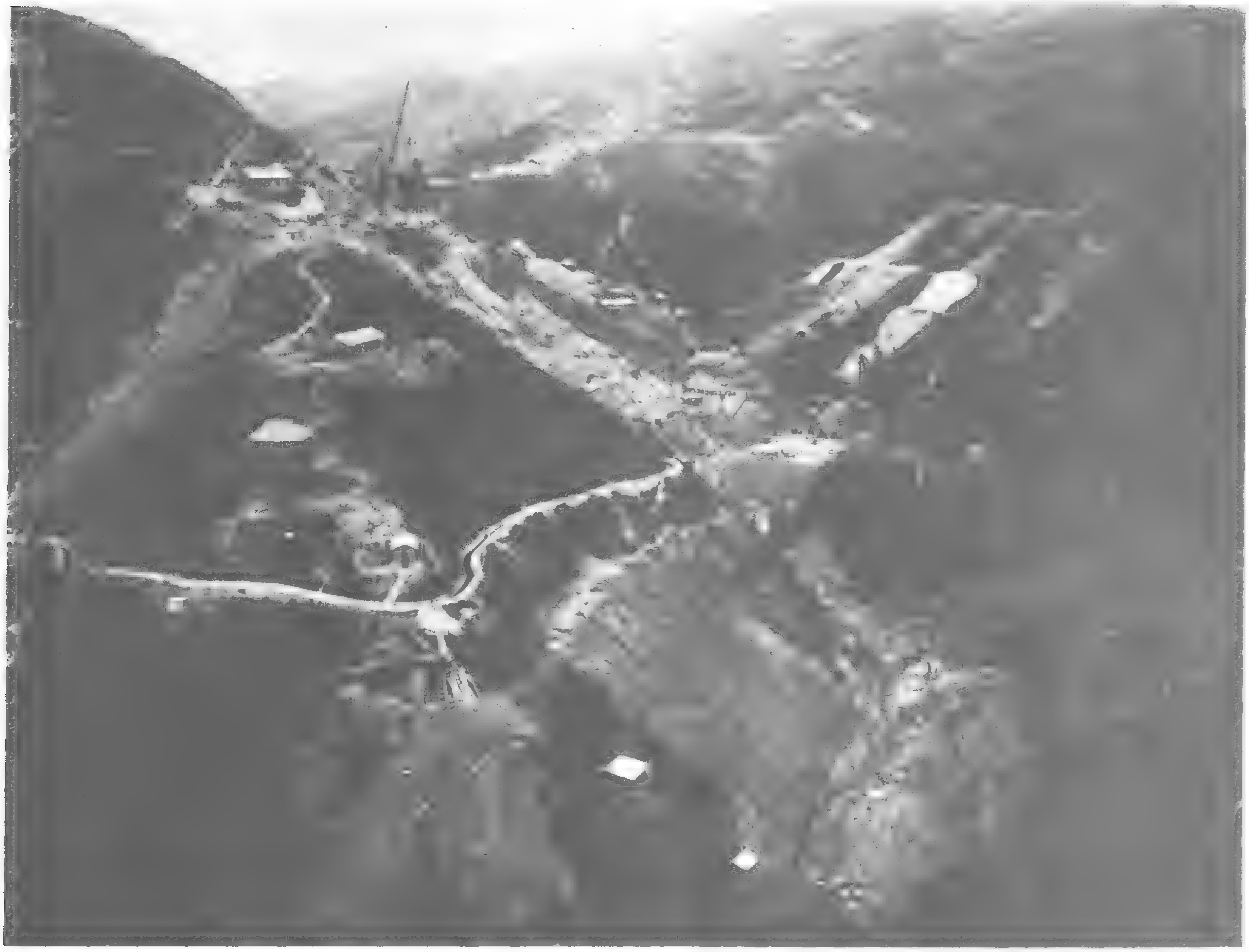

Fig. 9.—A general view of the Shing Mun Works, the Gorge and Valley looking upstream

drought in 1929 lead one to believe that even then a minimum a million gallons a day ran to Kowloon.

In the heavy rains a raging torrent rushes through the gorge : on a recent occasion (1931) it washed away the road near Shatin.

The river has, in centuries carved its way from this watershed through the gorge, which it seems to have entered just about where the dam is situated ; actually the gorge begins about 400 feet upstream of the dam site.

Down the gorge, commencing not far below the head of it, a series of pretty waterfalls were to be seen as the stream made its way to the sea some four or five miles distant, where the outlet is near to Shatin.

The builders of the dam had to prepare for all possible emergencies : they knew that if a cloudburst occurred in the Tai Mo Shan district there would be enormous volumes of water rushing into the reservoir. The design for the dam is such that this water must not flow over the top. Nor must any of the work of construction be carried away by the stream in the rainy season.

The site for the dam obviously had to be somewhere as near to the entrance of the gorge as possible Down the gorge the waterfalls are of varying heights some of much bigger drop than others. Actually the dam is below the first waterfall, because good foundation could not be found above the fall. Any dam built below the next waterfall would have to be correspondingly higher. Thus it will be seen that the engineers were to some extent limited in the choice of a site.

The Dam Foundations

The most important part of a dam is that portion which is never in evidence, once the dam is built, viz the foundations ; and the engineers at Shing Mun had to be certain about the foundations for this great structure.

They met with all sorts of difficulties as they explored the situation. The bed of the stream presented no solid rock foundations, right across the stream at any one place, except at prohibitive depths. Finally it was decided to build the dam in the narrowest part of gorge, but this is below a waterfall. It was found that it was impossible to build either an arch or gravity dam above the fall because of poor foundations. The builders therefore had to face the fact that placing the dam below the fall involved the additional height of 40 feet to obtain the same top level that a lower dam above the fall gave.

Then again, they had to consider the material on each bank. For, remember, the dam has to be, as it were, locked into each side of the gorge, by means of a concrete tongue-piece. It would result in a catastrophe if the water leaked round either of the extreme ends of the dam, or beneath the foundations, or through the material of the dam itself.

The Arch Dam Scheme Abandoned

When the Shing Mun scheme was suggested it was realized that, to hold up the desired quantity of water, a high dam would have to be built. Exploratory borings were made and there was reason to hope that firm foundations would be found nearer to the entrance of the gorge. As more data became available it became obvious that a great deal of caution was needed before the exact position of the site was finally decided.

Rather more than a year ago (14/3/33) Mr. Hull gave to the Hongkong Rotary Club a talk concerning the work at Shing Mun. At that time, although preliminary designs for the dam had been worked out, there was not sufficient data about the foundations and other local details to enable him to state definitely what type of dam was to be selected.

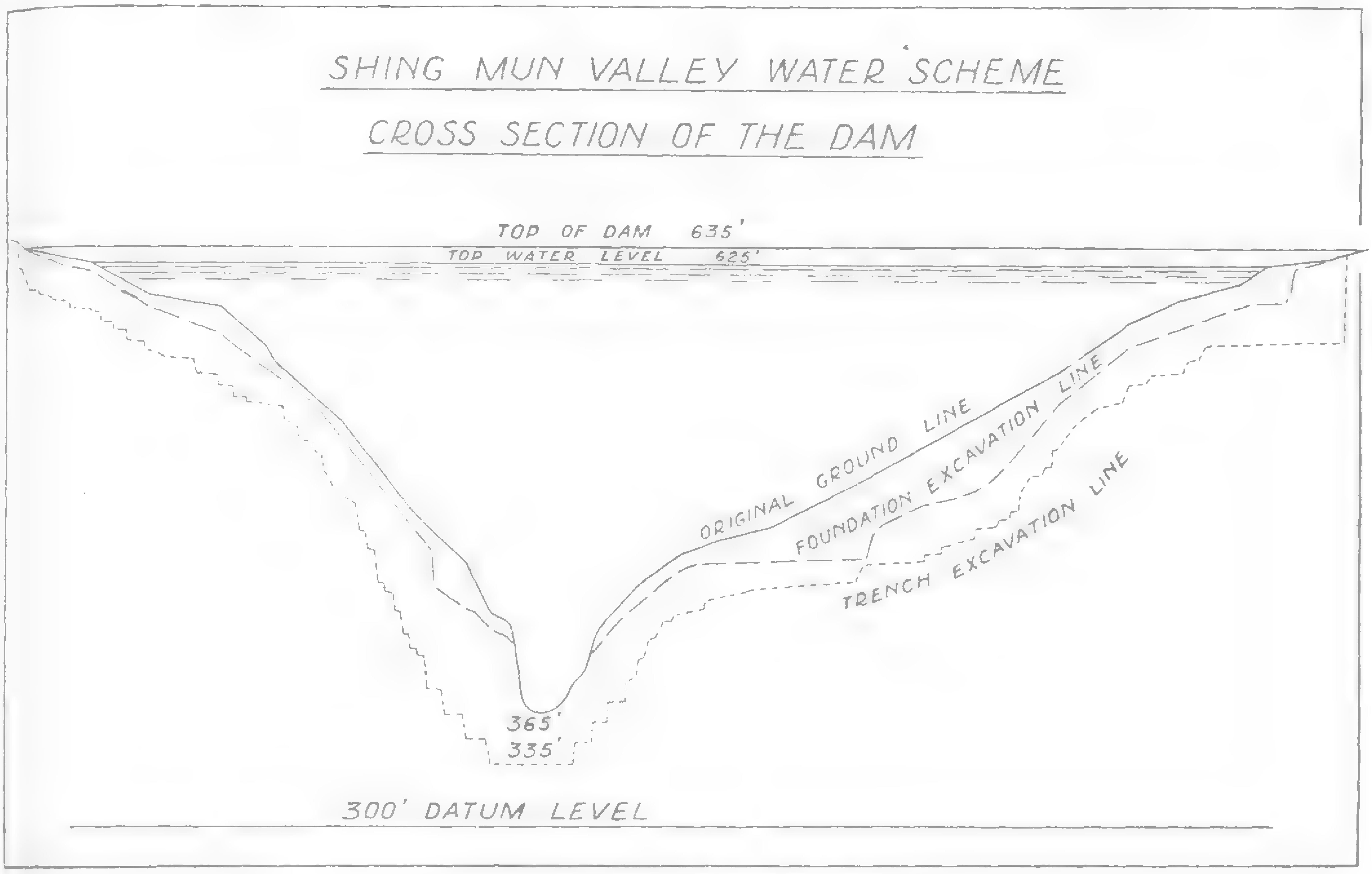

Fig. 9A.—Cross Section of the Shing Mun Dam

He did say, however, that of the different classes of dam viz.. the gravity dam, the arch dam, the multiple arch dam, the rock fill dam, the earth dam, and the hollow reinforced concrete dam, the Consulting Engineers had selected two—the gravity and the arch—as being most suitable for the characteristics of the Shing Mun Valley.

The writer was present at that meeting and listened with great interest to Mr. Hull's very lucid explanation of the problems connected with dam construction. He obtained the impression that, at that time the idea of the arch dam for Shing Mun was favored.

Subsequently more data was obtained from borings, etc.. on the site and it was decided, finally, to design a gravity type dam built partly of concrete, and partly of hand packed granite. There are many original ideas incorporated in the design and construction. It is by no means a standard design that has been planned. When complete the structure will be of colossal proportions. It will weigh nearly two million tons. It will be 300 feet high from the base of the foundations. The thickness at the base will be nearly 600 feet.

Mass Production Methods

On the occasion referred to above Mr. Hull mentioned that it might be said that the gravity dam is the most expensive type of all the dams. As its name implies, it resists the overturning pressure of the water by its weight. Usually built of concrete or very large stones embedded in concrete, when compared with the disadvantage of higher costs, it has the advantage that a spillway can be easily incorporated in the dam. It is also easier to build because the large dimensions enable what might be called "Mass Production" methods to be employed.

There can be no doubt the employment of mass production methods on the work at Shing Mun. The dam site presents an astonishing appearance.

You see cable ways, cranes, gantrys, locomotives, lorries, electric motors, air compressors, rock crushers, concrete mixing machines—everywhere power is in use. There are as many as 30 electric motors coupled to such machines as compressors, crushers, concrete mixers, pumps, derricks, elevators, etc. They vary in size from 150 horse-power to 6 h.p.—the total power available being 1,600 h.p.

In spite of the temptation to employ muscular energy, because of the comparatively cheap daily wage in this part of the world, Mr. Hull has employed the machine wherever possible.

He explains that, in the matter of cost, it is not only the daily wage that counts. There is housing, water supply, sanitation arrangements, medical attendance and the inconvenience caused by absence from duty for all sorts of reasons, from sickness to "urgent family affairs."

And beyond all else is the time factor. The machine works so much faster than the man.

The Choice of the Site

Although already mentioned, yet it must be emphasized that in the construction of any big dam the formation of possible sites greatly affect the final decision as to the exact place at which the dam shall be placed.

It is most essential that the foundations shall be reliable. Remember that any dam has to fulfil two main conditions. It must not allow the water in the reservoir to leak through it. And it must be of sufficient stability that, for an indefinite period, it will be able to withstand the pressure of the water on its upstream face. In common with all engineering structures a dam, properly designed and built, has a factor of safety in case of unexpected conditions setting up unusual stresses.

In that connection it is as well to remind readers that there have been in other parts of the world terrible calamities caused by the bursting of dam holding up large volumes of water.

Perhaps the worst in recent years was the devastation in California of the St. Francis dam, built for the water supply system of San Francisco; about 1,200 people lost their lives. That catastrophe was supposed by some to be caused by poor foundations at the sides combined with an inadequate section—(no allowance for uplift)—but opinions are not unanimous.

There is one other matter which cannot be ignored in dam construction—that of cost. You can do almost anything in engineering work fairly easily if you don't consider the expenditure. But the clever engineer builds economically as well as for safety. So that many factors had to be very carefully considered in the design and construction of the Shing Mun dam. It would not surprise the writer if, in the final results, the costs are remarkably low at Shing Mun as compared to those elsewhere. For a few casual enquiries on the site revealed costs that were very low indeed—no doubt cheap labor, efficient mechanization, an ample supply of granite in the district, and careful planning and organization have all been factors to produce economy.

There are, of course, many hundred of dams that are to-day holding up very considerable volumes of water. There are eight dams—all in the U.S.A.—of greater height than that at Shing Mun; but the famous Assuan Dam in Egypt is only 144 feet high whereas that at Shing Mun is 300 feet high. And the dam at Johore which retains water for Singapore is only 120 feet high. Although the height of the dam complicates matters, if all other conditions were favorable, and cost were no barrier to the scheme, it would be possible—if not economic—to build a dam 1,000 feet high. Every foot higher that the dam is raised increases, very much, the storage capacity but it also greatly increases the total bulk of the dam, and therefore the cost.

Fig. 10.—Shows Quarry where granite is won and also, in center of picture and at bottom, part of the Rock Fill and part of the Thrust Block

It must not be supposed that all dams are alike, either in design or in construction. Every one of them presents certain problems, if only those due to local conditions. And this dam at Shing Mun is original in many details.

In the course of time, probably, the designers, the Consulting Engineers in London, will contribute to the Proceeding of a learned society a detailed account of the many and varied problems which they had to keep in mind in connection with this dam. No doubt they will, in due course, give the reasons which led them to this very unusual design. It would be discourteous to attempt, in any way, to anticipate here such a contribution to the world's knowledge on dam construction: nor could it be done in any reliable manner, because so much of it would simply be guess-work.* But the writer has had sufficient experience of the subject to be able to express his intense admiration, not only for the ingenuity of design, but for the courage of those who decided upon it.

A Huge Reservoir

A picture, taken on July 27, 1934, at Shing Mun is shown in Fig. 9. This general view of a portion of the Shing Mun valley is of especial interest as it shows much of the general arrangement of the works and the lower portion of a part of the dam itself.

Running from about half way up the left hand side to about the center of the picture is a concrete channel. This carries water collected upstream (well above the dam site) in the channel and on through tunnels to Kowloon. This is the present, but inadequate, help that the Shing Mun valley provides for the water supply system of Kowloon and Hongkong.

If you follow the course of this channel from the left hand side of the picture to the center (the water in it flows in the opposite direction) you can see the lower portion of the dam itself. The flume through the dam draining water from the upstream face is shown with water falling into the river bed; on the right hand side of the river bed lower down the stream can be seen the outlet of the tunnel through the hillside. From the outlet, during construction, has emerged flood water held up by the dam: on completion of the dam the over-flow water, when the reservoir is full, will pour out of this outlet from the tunnel.

Above the dam site can be seen the area of the valley to form the reservoir. The European bungalows in the center upper part of the picture are above high water level.

Below, and to the left of the picture is the concrete mixing plant. As far as a cursory view of the valley from the bungalows can be depended upon, it appears that at no part of the reservoir will the depth of water exceed that at the upstream face of the dam. And as the reservoir will hold 3,000 million gallons it is obvious that a

Fig. 11.—Excavating on the South Bank to make Trench for the Concrete Tongue Piece

*Since writing the above the author understands that such a paper is being prepared.

very large lake will be formed behind the dam when to water level is reached. The picture shows only the beginning of the dam. It will ultimately close the gorge rising nearly as high as the crushing plant on the left of the picture.

Fig. 12.—The Crushers and Screening Plant

The New Dam

The dam is one of the most interesting, and possibly one of the greatest, engineering feats planned in recent years in the Far East. The project was mentioned in general terms in the *Far Eastern Review*, June, 1933. Since then many important modifications in the scheme have been made. It is as well to remind readers of its purpose and the work now in hand. Not only has good progress with the work has been made since June, 1933, but additional data is now available and has been made use of in a practical manner.

The new reservoir formed by this dam when completed will have an estimated storage capacity greater than the storage capacity of all the other eleven reservoirs in the Colony, including those on the island and mainland.

The storage capacity of a reservoir is limited by the physical features of the site as well as by the height of the dam. The capacity of the Assuan reservoir in Egypt was limited for very special reasons. The temples on the island of Philae had worshippers, whose vigorous protests against the submersion of these buildings resulted in the dam being 26 feet lower than was originally intended. That made the storage capacity less than one-half of what it would have been with a dam 26 feet higher. Patience on the part of the administration, and the proof of the great advantages that resulted from the storage provided by the original Assuan reservoir, seems to have been factors that have changed public opinion on the subject in Egypt, for the dam at Assuan has been raised recently and an enormous increase in water storage is the result.

Fig. 13.—The Elevator supplying Mixer Bins with Screened Aggregate from the Crushers

The Hongkong Government had a great deal of trouble with the villagers in the Shing Mun Valley.

It became obvious that their homes and rice fields would be submerged by the Shing Mun reservoir. Although generous compensation was offered to them they refused to leave their birthplace and the homes of their ancestors. It was a most difficult problem but finally they were accommodated in new and better homes in other parts of the New Territory.

It is believed that the new dam when completed in about four years (1937) will be, of its type, the largest in the world. The building of the dam will involve the use of over 200,000 cubic yards of solid concrete and nearly 500,000 cubic yards of rock filling. If we take the specific gravity of the rock at three, then a cubic yard of rock weighs about 5,000 lbs—over $2\frac{1}{4}$ tons ; so the rock filling alone accounts for the colossal weight of material of over a million and a quarter tons. When completed the dam will have used nearly two million tons of rock, sand and cement.

The Shing Mun Dam

Although many details in design of the Shing Mun Dam are original, it may be classified as a dam of composite masonry and dry rubble, the latter being all hand-packed. The length of the dam from the water face to the downstream extreme edge of the dry granite rubble backing is about 600 feet. By far the biggest volume of the dam is this granite hand-packed rubble.

The difficulties that faced the designers were many and not the least was that of keeping the dam watertight. In the concluding contribution (Part VI) of this series it is hoped to discuss more fully many of the problems that affect dam constructions, subject of immense importance in the Far East, at present we can only briefly refer to the all important matter of keeping the dam watertight.

In some dams there is a central core, or watertight diaphragm, of steel plates embedded in a concrete base forming a junction with the bed rock. In such a dam the principle is accepted that the core stops the passage of water and the material each side merely acts as a support to resist the pressure.

At Shing Mun this problem of keeping the dam watertight has been solved in a most ingenious manner. Full allowance has been made for any movement caused by a slight displacement of the foundations of any section of the dam.

Between the concrete front face of the dam, and the much more massive thrust block of solid concrete behind it, is a diaphragm which enables a relative motion between the concrete face of the dam and the thicker concrete thrust block behind it. It is this diaphragm which is relied upon to prevent the leakage of any water through the dam.

A Novel Design

It is not easy to understand the formation of the Shing Mun Valley gorge (Fig. 9), that is now being blocked by this great structure of concrete and granite backing.

The original stream bed narrowed considerably at the gorge, and at about the narrowest part of the stream bed the water-face of the dam is being raised. But almost immediately below this water-face the stream bed widened out, so that although the water-face of the dam a few feet above the level of the stream bed is only about 30 feet wide, yet downstream the width of the material across the stream bed is ever so much greater.

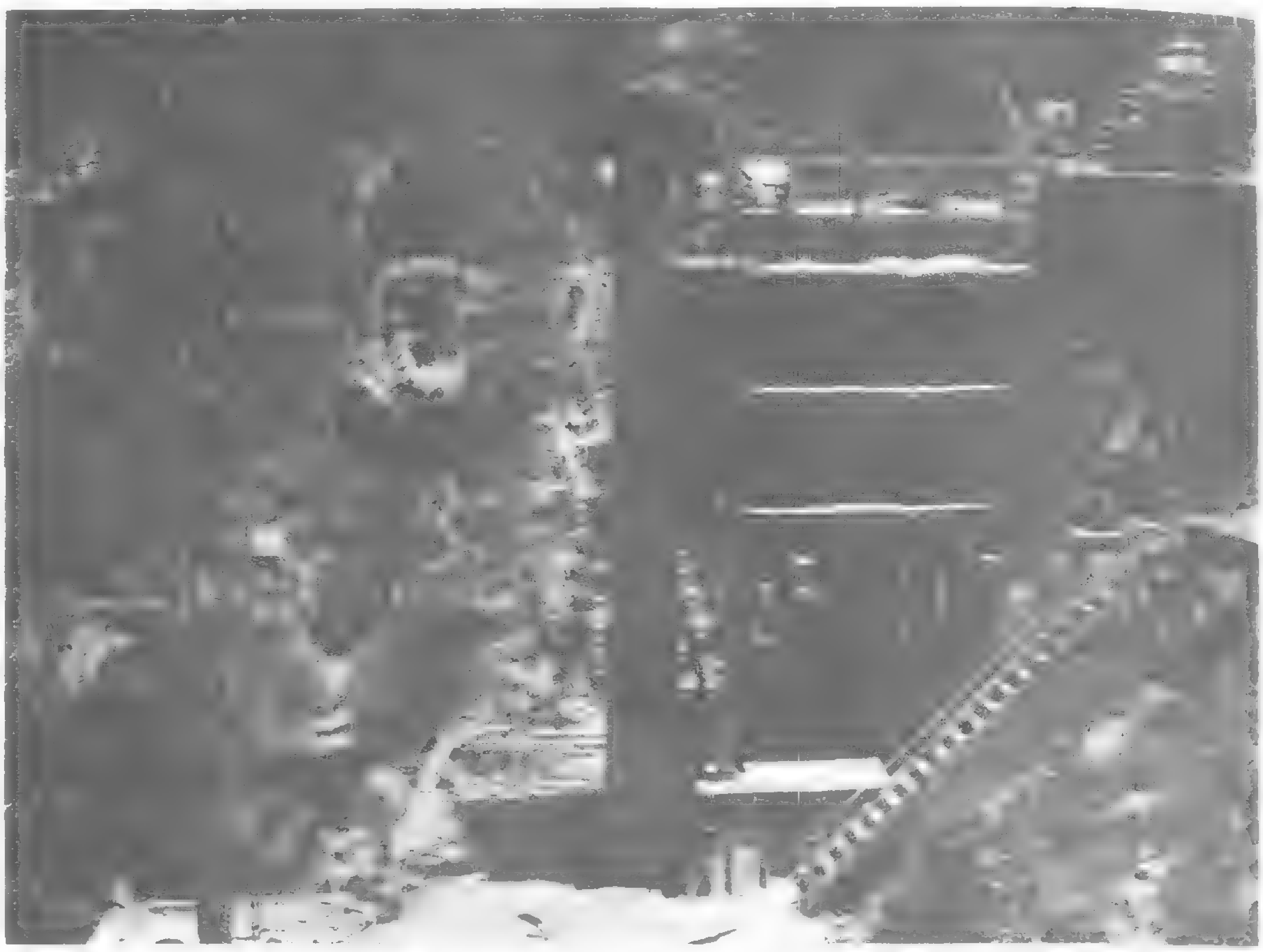

Fig. 14.—The Sand Elevator to Concrete Mixer Bins. This carries Sand from Crushers to the higher level of the Bins

Similarly at top-water level. The width of the top edge of the water-face of the dam spans nearly 800 feet across the gorge at the point, but the valley widens out, not only at the stream bed, but all the way up to the level of the height of the dam.

Fig. 15.—The Concrete Placing Tower

Moreover the stream bed itself falls away quickly, for there were small waterfalls below where the water-face of the dam now stands. Thus at the water-face of the dam the Datum level is 365 feet at the lowest part of the stream bed, but at about 600 feet down stream, where the lower edge of the dam ends, the level is considerably below that.

Of course the granite backing of the dam also tapers down as it is formed downstream. But the total volume of this granite backing is ever so much more than it would have been if the width of the gorge (i.e., the section at the dam water-face) had continued right throughout the length of the dam and if the stream bed fell in level much more gently than it does downstream.

The diagram (Fig. 9A) shows, roughly to scale, a section of the gorge at that place where the tongue-piece on the dam fits into the hill-side and, as it were, locks the dam watertight. The tongue-piece is very narrow in width as compared with other parts of the dam but it locks the dam into the trenches cut in the north and south banks of the gorge.

The diagram (Fig. 9A) shows the contour of the gorge before the engineers began to change it. It gives, also, the levels of the foundations for the dam at that section. And it shows how deep into each bank the narrow trench for the tongue-piece (of concrete) has been cut.

The Type of Dam

It will be remembered that the Tytam Tuk Dam (described in an earlier issue of this journal) was built entirely of concrete and on very firm foundations.

If the designers of this Shing Mun dam had decided to follow the same ideas of design, and the same methods in construction, the total cost of the dam would have been staggering. It would have been less if entirely of concrete, but still so huge as to be practically prohibitive in cost if only concrete were used. Although the volume of the rubble backing is the biggest part of the dam, it all has to be quarried and moved into position. As it is the Shing Mun Dam will absorb $9,000,000 (Hongkong currency).

Although the volume of the material used in the Shing Mun Dam is about seven times that of the Tytam Tuk dam (Shing Mun Dam contains 700,000 cubic yards of material), the time taken is estimated at a year less, mostly because of mechanization. At Tytam Tuk there was (practically) no machinery—all of the concrete was mixed by hand, all of the materials moved by hand labor. But at Tytam Tuk they were not far from the sea. The

Fig. 16.—Part of Thrust Block in Gorge showing the Flume for carrying off some of the flood water which collects on the upstream face of the Dam during construction

Shing Mun dam some of the material not found on the site (cement, machinery, etc.) has to be carried by lorries some miles to 635 feet above sea level.

Fortunately there is in the district surrounding the dam, an ample supply of granite, which forms a very large percentage of the volume of the dam. This granite has to be carried from the quarries either to the crushers, etc., where it is made ready for concrete mixing, or to that part of the dam which is downstream behind the concrete thrust-block where the granite blocks, and smaller filling, is carefully placed in position by hand.

The site at Shing Mun is one of the most awkward for the use of mechanical appliances that can be imagined. The hillside is so steep that it was difficult to obtain foundations for the heavy machinery. Nor could the most desirable arrangements be made for quarrying stone as the only reliable quarries were well down stream, some distance from the dam.

A view of the stone quarry is shown (Fig. 10). It is seen at about the middle of the right hand side of the picture. The rails for trucks and the cranes for handling the skips containing the stone are shown. Remember that the stone used in the concrete must be elevated to the crushers, which are placed above the top level of the dam, nearly 300 feet above the lowest part of the quarry now in use.

It may be said that, each day, about 1,000 tons of granite must be quarried and lifted across the valley to the crushers on the access road side of the dam. In addition some hundreds of thousands of tons of granite must be quarried and lifted into position behind the thrust block where it forms the great length of backing that will help to keep the dam stable against the pressure on the water-face. In all about a million and a half tons of rock will be transported to the site of the dam before it is finished. All of that rock will have to be quarried—and that involves blasting operations.

The Overflow Problem

Let us now summarize the salient features of the dam itself. The face that has water pressing on it directly is of extra rich concrete (mixture 690 lbs. of cement per cu. yd. of mixed concrete) so that it will be prefectly watertight. This rests on foundations which have been sunk 25 feet below the bed of the stream into rock of such a nature that it is impossible for water to seep underneath the dam—which might cause instability of the whole structure.

Behind this face of rich concrete is a thrust block of concrete (mixture 300 lbs. of cement per cu. yd. of mixed concrete). This concrete thrust block is an enormous structure although it is only a portion of the dam. For months the engineers have been pouring concrete on to the block to raise its height and although they have been pouring concrete at the rate of about 300 cubic yards a day, the thrust block is not yet anywhere near completion. The foundacions for the enormous weight of this thrust block do not go as deep as those mentioned above— they are taken to solid rock which, while sufficiently weight-bearing, is not necessary impervious to water. Between the face of rich concrete and the thrust block is the watertight diaphragm.

Behind the second or thrust block concrete section is the closely packed rock placed carefully in position by hand.

Two very ingenious joints are used in this huge dam, so that if the foundations of the thrust block or the hand packed granite portion should slightly settle, then there will be no undue strains on the whole of the structure.

There is a sort of a sliding joint (a watertight diaphragm mentioned above) between the downstream side of the rich concrete portion (the upstream side of which is the water-face) and the thrust block and between these two concrete masses are inspection galleries, etc., so that any deterioration of the diaphragm in the course of time can be at once detected and remedied.

Between the downstream face of the thrust block and the upstream face of the hand packed granite part of the dam, is a sand wedge which permits relative motion of either of these two portions of the structure without causing undue stresses which might affect the stability of the dam; so that the reader must visualize the whole dam in three sections.

The first, of rich concrete, is rigidly fixed on firm foundations which will allow of no movement of that portion of the dam. The second section is the concrete thrust block, much bigger in volume than the first section, but very much smaller in volume than the enormous mass of hand packed granite blocks behind it.

Both faces of this thrust block can move, although it is by no means certain that the block will in any way settle in its foundations. If it does settle a trifle both the upstream and the downstream surfaces simply slide down against the other portions of the dam. And if the front section of the hand packed granite block section

Fig. 17.—Part of Thrust Block on the South Bank

should settle vertically that can slide down into position without causing any inconvenience.

The design of the dam does not permit of the usual methods of dealing with the overflow when the dam is full and that part of the problem has been dealt with in a very ingenious manner.

In the gorge, a few yards higher upstream than the water-face of the dam, a tunnel 17 feet diameter has been driven into the hill side. It is 600 feet long and skirts right round the dam. It carries away a portion of the stream that is always flowing,—so that the construction of the dam is not interfered with, however, much rain may fall. That tunnel acts as a sort of circuiting stream, so that the dam is avoided by the water carried away during construction.

The Tunnels

But high up on the southern hill side another tunnel is driven at steep incline to meet that lower tunnel. When the dam is finished and the reservoir is full, this upper tunnel will act as spillway. It will have a large bell mouth 80 feet in diameter at its upper end ; and as soon as the level of the water in the reservoir reaches that of the bell mouth it will flow down the tunnel, round the side of the dam and out into the gorge beyond.

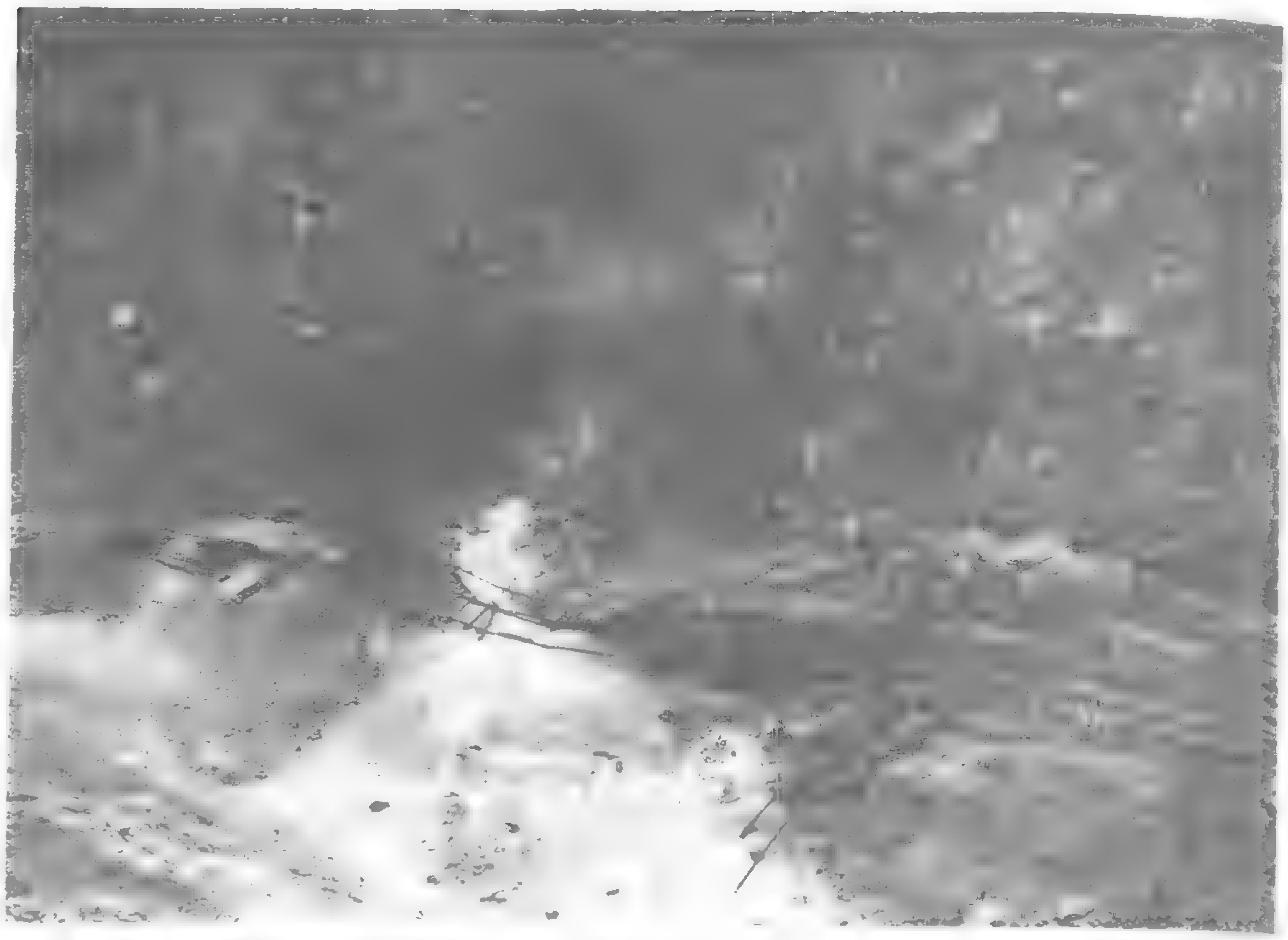

Fig. 18.—Showing Flood Damage at Quarry when the 17-foot diameter Tunnel was running two-thirds full

As already explained any flow of water over the top of the dam would be fatal as it must inevitably wash some of the loose rubble which forms that section of the dam at the part near the downstream face.

As the dam is being built across the bed of the Shing Mun river, arrangements had to be made to deal with the stream during construction and before the diversion tunnel 17 feet diameter was ready for use.

It will be remembered that, since 1926, a certain proportion of the stream has been flowing into the existing waterworks at a maximum of about ten million gallons a day. This is diverted from the river some distance upstream and has to some extent relieved the dam builders of trouble. But in the rainy season there is a much greater volume of water to be dealt with. Normally that would flow through the stream bed of the gorge, but now it must be diverted from the dam.

It was calculated that it would take about a year to complete the lower tunnel (17 feet diameter) designed to deal with this water. But it was undesirable to delay getting on with the work on the dam. There was the time factor to be remembered.

For the first few months of the construction of the dam temporary arrangements were made to divert any excess of the stream over the ten million gallons running to Kowloon.

A fairly wide flume (10-ft. by 5-ft) was built along the bank of the gorge. That will be abandoned when the tunnel is ready for use.

In addition to the flume, another flume or small tunnel was arranged at the stream bed in the center of that portion of the dam under construction. It should be explained that only the concrete thrust block and the hand-packed rubble portion of the dam was affected. The tunnel through the hillside is now completed, and carries away storm water that accumulates on the upstream face of the dam.

This small temporary tunnel, which was arranged to carry stream water through the base of the dam, will, as soon as it has served it purpose, be filled in.

It is not only necessary to construct this Shing Mun dam to make the great reservoir, but another retaining dam about 70 feet high, will be built at Pine Apple Pass to prevent the water escaping down that outlet. That will be an earth dam, with a concrete wall as a core, and on the upstream side there will be a granite face. That, of course, is a comparatively small affair as compared with the big dam, but it will use up a good deal of rock.

Fig. 19.—Repairing Quarry Railway Tracks after the recent flood

At Work on the Site

As one approaches the site of the dam, by the access road, one sees the staff bungalows and other buildings—including the coolie lines. Recently some new coolie lines have been built on a hill and there are two valleys for coolie lines as well.

One cannot fail to be impressed with the possibilities of the location for a residential area it one visits any of these European bungalows. It is about 650 feet above sea level—there are plenty of building sites on the small hills. When the dam is finished there will be a beautiful lake on one side and a glorious outlook on to the island-dotted sea on the other side. In imagination one can visualize a garden city of bungalows in the district especially if Tsun Wan Village near the sea, is cleaned up, as that is the only center of infection in the vicinity.

On arrival at the site one sees cables across the gorge, and skips containing five ton loads of broken granite crossing the gorge, at one

Fig. 20.—Inclined Railway for transporting Stone from Quarry at river level to Crushers

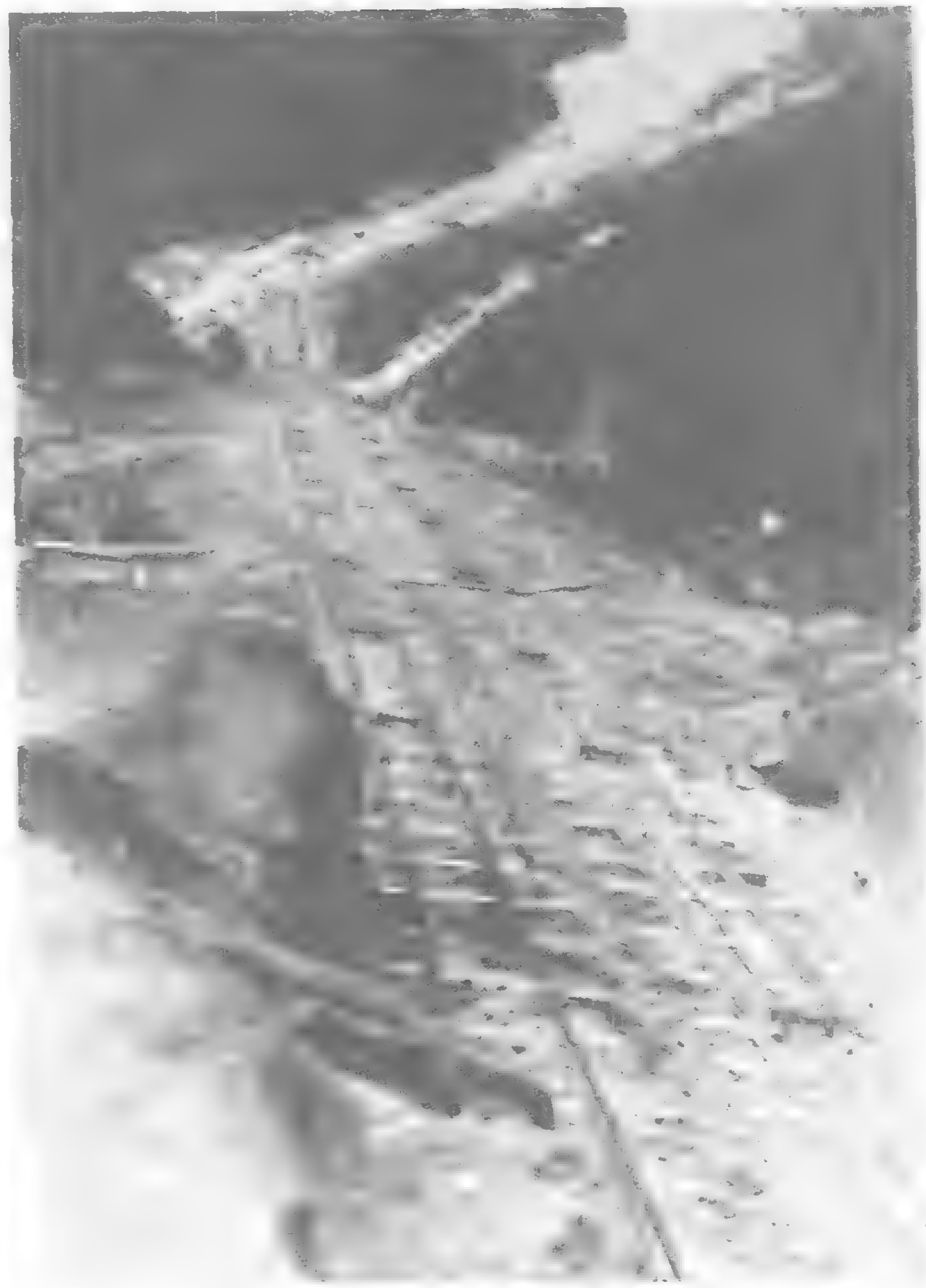

Fig. 21.— Inclined Railway for hauling material used in the Dam

place. At another spot a skip on a cable way is carrying concrete to the part of the dam where it is to be placed and remain for ever.

It should be explained that where the concrete is placed on rock the surface of the rock is most carefully prepared. All dirt is scraped off and finally wire brooms make the surface clean. Mortar is then spread over the rock surface, and on the top of that the concrete is laid.

Making the Concrete

There is a great din and rattle on the site—that is caused by the rock drills, the stone crushers, concrete mixers and other machinery. The rock drills are worked by compressed air: they are taking an active part in tearing down the hillside to provide granite blocks and rubble to be broken up for the concrete mixture and also granite blocks and rubble for the downstream body of the dam.

A considerable amount of granite was obtained when they were boring the diversion and overflow tunnels in the hillside. But the vast bulk of over a million tons of granite to be worked into the dam will have to be supplied from quarries on the sides of the gorge downstream below the dam. At first sight it seems a fairly simple matter to open a quarry at Shing Mun. But the location of the quarry and the relationship of its floor level with regard to the feed point at the crusher house are important factors as they affect the cost of haulage and the danger of interruption due to traffic breakdowns.

This provision of a sufficient quantity of granite was no easy problem. Every pound of it has to be put into skips, lifted by some sort of tackle, and carried to its final resting place. Every foot that it is carried costs power—and money and time. Obviously, then, the nearer the quarry is to the dam the more efficient is the transport.

But Nature was not concerned with the problems of dam construction when the Shing Mun gorge was created. In common with the rest of the land in the district, the gorge is composed of granite and decomposed granite. The former is found in boulders of varying sizes, standing like plums in the earthy substance which is mostly decomposed granite. It is also found in great masses in the form of boulders so huge as to weigh thousands of tons. And when that occurs the rock can be called a quarry. But the quarry gives a limited supply of granite: it is not an inexhaustible source of supply.

At Shing Mun the first quarry to be worked was some distance below the upstream face of the dam. Its base was at about the level of the stream bed.

For various reasons the stone crushers mixers, etc., were placed on the South side of the stream (Fig. 11) the same side as the Access road. This picture shows the work of excavation in the hillside on the South bank of the stream in the bank where the concrete tongue-piece will seal the water, and prevent leakage around the dam. It gives a good idea of the mechanization system now adopted in civil engineering work of large dimensions. At the lower portion of the picture can be seen trucks on rails. Above them are the derricks.

The first quarry was on the opposite side of the stream. So that in working this quarry all of the granite for concrete had to be carried over the stream and lifted to a height of about 300 feet from the bed of the stream to the crushers.

And so, on the dam site, we heard the ceaseless clatter of the compressed air rock drills. One sees the five ton skips swinging across the gorge, finally discharging the contents on to a dump near to trucks on rails. One sees granite carried in the trucks to the crushers where it was broken up by resounding hammer blows (Fig. 12). Thence it falls by gravity to the rotating screens. The pulverized portions fall on to a travelling endless belt to be carried to the sand hoppers; for pulverized granite forms good sand and is used in the concrete mixture.

The broken granite (aggregate is its technical term) after screening is carried up by a conveyor or elevator to the bins (Fig. 13). Alongside the granite bins are bins for cement and sand, and a water supply. The sand elevator is shown (Fig. 14).

It is an easy matter to vary the proportions of aggregate (granite broken into cubes of small size), sand, cement and water, according to the instructions of the engineer. The proportions for the day's work having been decided upon, the attendants at the mixers pull various levers and the ingredients fall into the mixers.

Preparation of Concrete

It is a well-known fact that the strength of concrete depends in a large measure upon the physical characteristics of the stone used for the aggregate. In this respect Hongkong provides splendid material, for the local granite is excellent for the purpose.

The gradation of the aggregate has also an important bearing on, not only the strength, but on the proportion of sand required for the concrete, and the amount of cement necessary for cohesion. By careful grading it is possible to cut down the volume of mortar (i.e. cement and sand) required to fill the interstices. And obviously mortar is more expensive than granite of the same volume.

At Shing Mun the crushers are what are technically known as jaw breakers. This is a relatively simple machine with faces accessible and easily renewed. The mechanism can be inspected without dismantling. The feed opening is rectangular. Feed sizes of larger size can be used than with the other type, the gyratory crusher. And the size of the finished product can be adjusted more readily. "But the gyratory type has its advantages, not the least being that the power consumption per ton crushed is less than in the jaw machine and the output is higher as it is crushing and discharging continuously." At Shing Mun there are several jaw crushers working continuously.

Fig. 22.—A view of the Dam from the Right Bank

The Screening Plant

It is desirable to separate the various grades of aggregate used for assorted mixes. Revolving screens are used for the purpose. These are marketed in various sizes. The screens are circular and vary in different machines, from 24 inches to 72 inches in diameter, the maximum feed per machine varying, in revolutions per minute, from $22\frac{1}{2}$ to $11\frac{1}{2}$.

In the 24 inch screens the diameter of the holes vary from $\frac{3}{4}$ inch to $2\frac{1}{2}$ inches. The crushed material is moved by conveyors. Those employed are of the belt and also the steel tray type, the latter for elevating.

Sand for the Work

At first it was hoped to use granite crushed into very fine particles for sand, but after some experiments it was decided to mix this granite—sand with natural sand in the proportion of fifty-fifty. The natural sand is brought along the Access road and must be carried a distance of about nine miles.

Thus we have traced out how the ingredients for the concrete are delivered to the place where it is mixed all ready for use.

When we come to the mixing plant, we see a number of bins. Some of these contain aggregate of different sizes, and others cement, and another sand while a supply of water is available.

All four ingredients—aggregate, sand, cement and water—fall by gravity into the mixing machine. Thence the wet concrete falls into a skip which is on a cable way. The skip passes to the position where the concrete is to be used. Under normal circumstances the skip empties into a hopper whence the concrete falls by gravity down a flexible chute to that position on the work where it is required (Fig. 15).

The container is carried on a steel frame resting on a concrete foundation, the latter at first some feet above the level of the portion of the thrust block being built. From the bottom of the container which is about forty feet above the concrete there are four flexible chutes. The wet concrete slides down the chutes and is delivered as easily as low pressure water out of a box to any spot within the radius of the chutes T. They spread the concrete over an area of about 50 feet by 50 feet.

As the level of the thrust block rises so the steel structure carrying the hopper is lifted up. Fig. 16 shows it in position standing on the concrete thrust block to which it feeds the wet concrete. The concrete foundation for it is raised and then the structure is placed back ready for use at a higher level. The foundations are incorporated in the thrust block. In Fig. 16 the steel structure is seen on the lower left hand side and the thrust block in course of construction is in the center of the picture. The lower part of the thrust block as it appeard on July 25, 1934, is shown in Fig. 17.

It should be mentioned that the typhoon rains in September, 1934, caused a good deal of damage at Shing Mun. Large quantities of water rushed down from the catchment area, causing floods. At one time the tunnel built to carry away this flood water—a tunnel seventeen feet diameter — was two-thirds full of water. The result was that the railway track was washed away (Fig. 18). As soon as it was safe to do so, men were put on to repair the track (Fig. 19).

Although that and other unexpected troubles, caused delay the engineers were determined to make up for the time lost. Many ingenious new devices were arranged so that time might be saved. Wherever possible rails have been laid (Figs. 20 and 21) even at steep inclines to facilitate transport and the work is being pressed forward as rapidly as is possible.

It naturally follows that, in spite of mechanization, a large labor force is needed and at Shing Mun about fifteen hundred Asiatics are employed. There are various opinions about the relative efficiency of Asiatic and other labor, but there can be no doubt that large civil engineering works can be carried out in the Far East at about half the price of similar works in England.

It is of course difficult to state what the final average costs on the different sections of the work will finally work out per cubic yard of material. During the writer's most recent visit to the works (Sept. 1934), he made enquiries as to the expense of placing the concrete on the thrust block i.e. the cost of carrying the material to the dam (after mixing) placing ramming, shuttering, labor and cost of power. In that week it was 25 cents (say 5d) a cubic yard. Handling the rock from quarry, crushers, screens, pulverizing and mixing, labor roll power, cost 35 cents. Both of the costs are remarkably low and it will a great interest to have details of these and other costs for the whole dam when it is finished.

The Time Factor

We may be sure that Mr. Hull will lose no time on this work, if forethought and experience on dam construction can help to save time, as it must.

A reference was made, at the beginning of the story of the Shing Mun Dam, to Mr. Hull's views about the value of time. When he addressed the engineering students of the University of Hongkong he elaborated this point in an interesting and original manner. He said that it might not be out of place to offer a few general observations on an aspect of engineering works which is often overlooked by those who are not thoroughly familiar with, or not deeply concerned in, the financial side of those works.

In exactly the same way it is necessary to take into consideration a fourth dimension, that of space-time, in trying to find the truth about the nature of the Physical world so it is necessary to consider a fourth dimension, that of "speed—quality" in the engineering world.

Large engineering works are often financed by money subscribed by the public, and in some cases provision is made for the payment of interest out of capital while the work is in progress and before any revenue is obtained from it. It follows therefore, that it is a matter of great financial moment that the work should be finished as speedly as possible in order that the interest may be obtained from revenue instead of from capital. Stored water, in addition to having potential energy, has potential revenue, and the sooner it is stored the sooner is it, that revenue becomes available. The effect of speed on the work is to accomplish this, and at the same time, of course, its effect is that the overhead charges, which in some cases are very high, also cease the moment the work is finished.

In some cases however, speed has often had a bad effect upon the quality of the work and it has now been established that a deep concentration on speed, which is not at the same time accompanied by a deep concentration on quality, is undesirable, and true engineering efficiency lies in organizing the works so that they can be built with the maximum speed campatible with maximum quality.

The Story Never Ends

This completes the description of the work that has been accomplished at Shing Mun. The work will continue without a break until the great dam is finished in about four years' time. And concerning the future, who dare to prophecy?

Shing Mun is in the New Territory and that is held under lease until the year 1996. What will happen after that date no one can tell. A wise man once told me that any one who could be fairly certain concerning his own career for the three years just ahead of him was a very fortunate individual. No one dare prophecy very far ahead concerning the future. In this generation we are living in a world that is changing rapidly. We have almost ceased to wonder at the marvels of science which have appeared in our time and which at first seemed incredible to us. We have witnessed astounding political upheavals—the disappearance of the autocratic rulers of Russia and Austria, the re-shaping of the map of Europe, the rise of Japan, and last, but by no means least, the astonishing political and social experiments of President Roosevelt in the United States. We have lived in a period of the amazing heroism displayed during the Great War and we have read of criminals who have ruined many innocent families—parasites on society such as Hatry, Insull and Strativisky.

And while all these things were passing across the flickering screen of time, many of them events to shake our faith in the future, we remembered, that in all parts of the world men were building splendid works which shall outlive them and benefit future generations.

Nothing less than a great and unexpected calamity, such as an earthquake, can destroy the great dam at Shing Mun. Like the Pyramids of Egypt it will outlive the actions and reactions of politicians; last much longer than the dogmas of theologians; survive the bickerings and quarrels of nations; remain intact while those who to-day are scrambling in the hurly-burly of fluctuating currencies and mercurial markets will be but ashes or skeletons buried in the earth. These great works of the civil engineer, like great inventions or scientific discoveries, and the best in literature, are the beneficient gifts handed on to posterity by the creators of this generation. They will remain as great landmarks for all time.

The story of the struggle to improve the conditions of life on this earth never ends. Every new work, such as the Shing Mun dam, is an incentive and inspiration for other works elsewhere. China must be affected by the examples to be seen in Hongkong.

The next and final contribution of this series, will discuss the probable developments of the future and the general results of what has already been accomplished.

New Ships for N.Y.K.

The Nippon Yusen Kaisha announce that a distinctive fleet of six express motor freighters of a gross tonnage of 7,300 tons each, and having a speed of 15½ knots, will shortly replace the six steamers and two motor ships at present on their Orient-New York Service.

The vessels will be completed and equipped under Ministry of Communications Special Survey, and also in accordance with the requirements of the highest class of Lloyd's Register of Shipping under Special Survey to class 100 A.I.L.M.C. and R.M.C.

Further, all details and construction will comply with the requirements for the British Board of Trade and British Factory and Workshop Act, and also be in accordance with the recommendations of the United States Public Health Service as well as of the United States National Board of Marine Underwriters.

Each vessel will have a straight stem raked forward with an ample flare, single squat funnel and a compact bridge, erection around the engine casing and a cruiser stern with a streamlined balanced rudder.

There are two continuous decks, upper and second decks over the full length of the vessel, with detached forecastle, bridge and poop decks.

A cellular double bottom is carried throughout the whole length of the vessel, the space of which is arranged for the carriage of either fuel oil or ballast water.

The hull is subdivided by eight athwart watertight bulkheads carried to upper deck, into fore and aft peak tanks, six cargo holds, seven 'tween deck spaces and a machinery room.

The *Nagara Maru*, *Naruto Maru* and *Nako Maru* will, respectively, be propelled by an M.A.N. two-cycle double acting airless-injection Diesel Engines to be designed and constructed by the Yokohama Dockyard Co., and have seven cylinders of 700 mm. in diameter, with a piston stroke of 1,200 mm., the normal output being 6,700 b.h.p. at 105 r.p.m.

The main propelling machinery of each of the three Nagasaki vessels: *Noto Maru*, *Noshiro Maru* and *Nojima Maru*, are of Mitsubishi Sulzer Type Diesel Engine, two-cycle double-acting airless injection, with seven cylinders of 700 mm. and with a piston stroke of 1,200 mm. and will develop 6,700 b.h.p. at the normal load at 106 r.p.m. In both instances the single screw propulsion is adopted following the recent tendency of high powered freighter and a much better performance is expected in comparison with the ordinary twin screw plant.

The vessels will, with ease, attain a speed of 18½ knots at trial, and it will safely be expected that they can make a continuous run at 15½ knots when fully laden at sea, and that an excellent schedule will be guaranteed between Orient ports and the U.S. Atlantic ports.

In order to combat any possible outbreak of fire on board, a complete Lux Rich fire detecting and extinguishing system is installed for the protection of all cargo holds and 'tween decks, including silk rooms and mail room, all in accordance with the latest requirements and recommendation of the New York Board of Underwriters and the United States Steamboat Inspection Service.

Air is constantly drawn from the holds and other strategic points, through pipes of a small bore carried to a smoke-detecting cabinet in the wheel-house and are under the constant watch of an officer in charge.

The same pipes are used to discharge the CO2 gas from the extinguishing apparatus to a place of outbreak by the simple turn of a lever.

The cylinders containing liquid carbon dioxide under pressure are stowed in CO2 room of special construction situated at the starboard side of the bridge deck.

The vessels are constructed to be ratproof throughout, in accordance with the general instructions issued by the U.S. Public Health Service, and special care is paid to all parts of the vessel to be built so as to be free of rat harborage.

State Plans for Industrial Development in China*

Newsprint Factory

The art of paper-making has been practised in China for about two thousand years, but little progress has been made in improving the quality, originally used solely for writing and later to include woodblock printing. When the modern industrial era opened in China, mechanical printing rapidly displaced all older forms, but the paper used for press work must have great tensile strength and other qualities which Chinese hand-made paper does not possess. Consequently with the exception of those descriptions used for stationery and painting, supplies of paper for printing, wrapping, and other purposes are imported.

China's paper imports have increased very rapidly. In 1908 the paper imported was worth about three million Haikuan Taels, but in 1932 had increased to approximately $54,000,000. With the educational and industrial demand developing at their present pace, China's consumption of paper will increase considerably as time goes on. With the object of helping to make China to a certain extent self-supporting in regard to paper supplies, the Ministry of Industry plans to establish a newsprint factory. Paper of this description represents about 34 per cent of China's total paper import, and though inferior in quality to M.G. Cap, the cost of manufacture is considerably less, and it is suitable not only for newspapers but for textbooks and many other descriptions of printed matter. After careful consideration the Ministry decided that the establishment of a newsprint factory should be the first step in developing the paper industry in China.

The following table shows details of the quantity and value of paper and wood-pulp imports during 1932 :—

	Quantity (*piculs*)	*Value* (*G.U.*)
Paper board	—	3,515,013
Cigarette paper	—	3,189,039
Art printing paper	41,951	808,050
Newsprint (in rolls)	231,435	1,517,360
Newsprint (in reams)	703,496	5,945,060
Drawing, bank-note, and bond paper.	—	650,115
Calendered paper	13,620	362,439
Paper labels	663	21,711
M.G. Cap	495,283	4,895,874
Packing and wrapping paper.. ..	183,383	1,773,428
Parchment	—	707,029
Tissue paper	14,211	279,497
Wall paper	—	138,320
Paper, N. O. R.	394,323	5,457,564
Total	—	29,260,499
Chemical Pulp	77,046	410,437
Mechanical Pulp (Dry)	8,038	32,879
Mechanical Pulp (Wet)	80	731
Total	—	444,047

The Ministry's scheme for executing a paper-mill was included in the Plan for the Establishment of Basic State Industries, which was approved by the Central Political Council, but owing to financial difficulties has not yet been realized. In 1931 the Ministry of Education ordered all Chinese publishers to use home-made paper in printing books in Chinese and school-textbooks, but the Shanghai Publishers' Guild pointed out the impossibility of doing this, and suggesting the establishment of a paper-mill to be operated by the State, or in co-operation with private business interests. Fully aware of the importance of paper in the cultural and educational development of the country, the Ministry of Industry entered into negotiations with Shanghai publishers and newspaper-owners with a view to devising ways of co-operation. An estimate of raw materials available in the country was made by investigating the resources of various forest areas, and at the same time an investigation was made into the hand-made paper industry, with a view to improving the output and to avoid the possibility of unemployment among a large number of workers in this field following the establishment of the proposed newsprint factory. At the end of 1932 experts were sent by the Ministry to Chekiang to investigate available resources for raw material and water-power, and it was found that in Wenchow and Chuchow there are abundant supplies of fir and Liushan a variety of *Cryptomeria Japonica*, for making paper, while a stream known as the Hsiaochi, at Wenchow was capable of developing power.

In order to obtain a more exact estimate of the cost of erecting a hydro-electric power-plant, the preliminary inquiries were divided into five sections :—(1) to ascertain the area of the cross-section, velocity of current, and volume of water-discharge, (2) exhaustive study of the discharge, (3) detailed survey of a site for the dam and power-plant, (4) drilling and boring of the river, and (5) a small-scale experiment in power generation. With regard to the first two parts of this work, the Chekiang Conservancy Board has given a satisfactory report that conditions are favorable for building a hydro-electric power-plant to supply power to the paper-mill. The third part of the investigation was entrusted to expert engineers of Messrs. Siemens (China), while the fourth is under the care of the Bureau of Mining Administration, in the Reconstruction Department of the Chekiang Provincial Government. The last part of the investigation—establishment of a small-scale plant for experimental purposes—will be effected in accordance with the data supplied by Messrs. Siemens.

It has been decided that the paper-mill should be capable of a daily output of 35 tons of newsprint, and on the basis of 330 working days a year, the annual output will amount to 11,550 tons. At the present time the *Shun Pao*, *Sin Wan Pao*, *Eastern Times*, and *China Times* consume over 10,000 tons of newsprint annually, while the Commercial Press, Chung Hwa Book Company, the World Book Company, and other Chinese publishers in Shanghai use a very large quantity of this class of paper. As the output of the paper-mill to be established will not be sufficient even to meet the requirements of Shanghai alone, the Ministry feels there will be no difficulty in disposing of the output.

The minimum estimated cost of establishing a paper-mill and hydro-electric plant is $4,100,000, and it has been decided that this capital is to be furnished by the Government. The £250,000 from British Boxer Indemnity Fund which was at first allotted for the establishment of an ammonium sulphate factory will be used for the paper-mill, as the sulphate factory is being established by private interest. This sum and another £80,000 from the British Boxer Indemnity received by the Ministry of Industry, amounting in all to about $4,800,000, will be used to supply capital for the new paper-mill, this plan being approved at the 148th meeting of the Central Political Council on February 20, 1934.

Supply of Raw Materials

Suitable timber for making paper is abundant in the districts of Lungchuan, Chingyuan, Chingning, Yunho, Sungyang, Suichang, Hsuanping, Chinyun, Lishui and Tsingtien, which are large tracts of mountainous country. Fir is the principal variety of timber found in these forests, with liushan and pine coming next. In addition to supplying the local demand for timber, fir and liushan to the value of $5,000,000 are exported from this region annually, of which about two-fifths goes from Chuhsien, and three-fifths from Yungchia. The district of Lungchuan produces the largest amount of timber, with an annual output worth approximately $1,000,000. The annual output of Yunho and Suichang is about $500,000 each, and of Chinyun and Chingning about $4,400,000 each, while that of the other four districts is smaller. The

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following shows the quantity of timber shipped from various centers in this region :—

(1) About 500 whole-piece rafts, containing 105,000 pieces, and 80 eight feet log rafts, containing 40,000 logs, are exported annually through Wangyu from the western part of Lungchuan, while about 50,000 eight feet logs are exported through Anchi.

(2) About 200,000 eight feet logs are exported annually from Sunkengtsun in western Lungchuan, but of this number, only 30 per cent is produced locally, the rest being from Puchen and Sungchi, Fukien.

(3) About 100 whole-piece rafts, containing 24,000 pieces, and 800 eight feet log rafts, containing 400,000 logs, are exported annually from Hsiaomeichen in southern Lungchuan, but only about 30 per cent are produced locally—50 per cent coming from Chingyuan and 20 per cent from Sungchi and Chenho, Fukien.

(4) 50,000 eight feet logs are exported annually from Chatienssu, in southern Lungchuan.

(5) 150,000 eight feet logs are exported annually from Yuchangtsun, eastern Lungchuan.

(6) 300,000 eight feet logs are exported annually from Anjenchen eastern Lungchuan.

(7) 500,000 eight feet logs are exported annually from Shawanshih, eastern Lungchuan. Most of the timber exported from this place, however, is the product of Santu, and Ssutu though some comes from Chingyuan.

Exports from other sections are smaller in quantity, and detailed figures are not available.

With regard to the area of forest land, no precise figures could be obtained, as such land is exempt from taxes. The following estimate is based on a report by Mr. Chen Pu Yun, Chairman of the Lungchuan Chamber of Commerce :—

Location	*Sq. Li.*
Lungchuan :	
Chuchi	3,200
Patu	2,400
Sunkeng (including a section in Chingyuan)	900
Chatien	1,250
Yuchang	450
Anjenkou	1,400
Lishantou	200
Taotai	1,600
Shangpeihsiang	250
Chingning :	
Santu	1,350

Timber-Felling and Transportation

Buyers usually go to the forests to buy timber, where height and girth of trees in the designated area are measured and recorded. Length is usually estimated in logs of eight feet, which again divided into classes according to diameter—4-in., 6-in., 7-in., 8-in, and so on. Timber below 2-in. in diameter is usually not included in the sale. After the price is agreed upon, the trees are felled within a definite period. Owners of forest land who are in financial difficulties often sell their timber without regard to size, and on account of shortage of funds fail to re-plant the cleared area. Consequently many regions formerly thickly wooded have now become denuded of trees. A well-to-do owner sells only timber of more than 6-in. in diameter, smaller sizes being left to grow.

The felling period begins in May and ends in September, because trees felled during this season are easily barked. Timber barked in June is often found to have black spots on it, so work is usually suspended during this month. After being barked trees are left on the ground to dry, and are then sawn into logs. These are marked by the timber merchants and piled up on the river bank, being lowered into the current at high-water. When the logs arrive at the collecting place, each merchant collects his own timber recognized by the marks on the logs. Next, the logs are made into rafts and transported to Tsingtien or Wenchow for sale. The cost of felling and barking a tree ranges from 7 to 10 cents, while the cost of carrying timber from a forest to the nearest river-bank varies on account of the difference in distance. If the trees are far away from any stream, no one will buy the timber, even though it is of excellent quality, because the cost of felling and transport will exceed the market price.

From the collecting place the logs are made into rafts and transported to Hsiaochi or Tachi, a charge of $10 being made to navigate the raft from Shawan to Hsiaochi, and another $12 for making it. Timber from Sunkengtsun or Lungchuan is usually transported from Tachi to Wenchow, and the cost of making and navigating a raft is about $75, while from Hsiaomeichen the cost is about $70.

Tsingtien and Wenchow are the principal markets for timber exported from Tachi and Hsiaochi. Timber sold in Tsingtien consists mostly of uncut pieces about 20 feet in length, and non-standardized logs. About one-third of the latter are liushan (a variety of *Crytpomeria*), while those from Suichang and Sungyang are 20 feet fir logs, nine feet pine logs, and eight feet liushan logs. Timber marketed in Wenchow consists principally of eight feet fir logs, though the number of uncut pieces, about 20 feet in length, sold is considerable. The timber hongs of Tsingtien and Wenchow charge a commission of six per cent and warehousing expenses for timber sold through them. Generally 12 cents has to be paid to a hong for selling one eight feet log. Although a number of dealers buy timber at the producing centers with their own capital, most of the merchants do business with money advanced by the hongs at a very high rate of interest, the lowest rate being two per cent per month. A dealer who borrows money from a hong must also sell his timber through that hong. Sometimes, on account of an unfavorable market, timber is kept for two or three years in warehouses before it can be disposed of profitably. Recent reports show that one eight feet log sells at about 95 cents, out of which commission and charges amounting to 12 cents are paid to the hong. Five or six years ago, eight feet logs were sold at 50 or 60 cents a piece, but owing to rises in the standard of living and the higher cost of labor during recent years, prices have gone up also. Bandit disturbances in Fukien, which not only stopped timber exports from that province to Chekiang, but also caused Fukien merchants to buy from the latter, also contributed considerably to this upward trend, but prices at the actual producing centers are as low as they were several years ago.

On account of differences in soil and climate, the shape and length of the wood fiber in timber grown in different places varies considerably. Fibres of fir and liushan grown in Eastern Chekiang have been tested by the National Institute of Geological Survey, and found to be flat in shape and with pointed ends. Fiber lengths have been measured by the Agricultural Department of the Central University, fir being found to have an average length of 3.5 mm. and liushan an average of 2.9 mm. These results show that both varieties are suitable for paper-making, and although the fir fibre is longer than liushan, the latter is more suitable owing to its cheapness.

Although market prices of Chekiang timber have gone up during the last decade, prices at the producing districts have undergone little change in the past twenty years. It seems reasonable to assume that only a very small portion of the forests has been cleared, and as only 40 per cent of the land suitable for timber is actually forested, by buying land from the Government and private owners at reasonable prices, the factory can secure its own forests and obtain timber at very low cost.

As it takes 15 years for liushan and 25 years for fir to grow sufficient to be suitable for paper-making, the factory will have to buy its timber at the beginning of operations. In order to prevent market manipulation by timber owners, it has been decided to take the following measures in obtaining timber for the factory :

(1) To organize a purchasing department, in which persons thoroughly familiar with the business will be employed. Prices for timber are to be fixed by the factory and bought from merchants willing to supply the factory at the stated rates for a period of three or four years. Contracts must be concluded between merchants and lumber-owners in order to avoid exploitation by the latter.

(2) To establish a purchasing office in the factory, to which any person willing to sell timber at prices fixed by the factory may apply. Purchasing agencies will be also established at various distributing centers.

The supply of timber in Wenchow and Chuchow is so abundant that there will be no difficulty in supplying a paper-factory with a daily capacity of 35 tons.

Plan for Hydro-Electric Scheme

Dam.—It is planned to build a concrete dam with four steel roller wires of 7 by 35 meters each. At the point where the dam

is to be built, the width of the stream is 181 meters. The dam will cause no inconvenience to nearby villagers, for even in time of floods the roller wires can be lifted in a few minutes and the water released. It is estimated that when this dam is built and two turbines installed, current representing 5,400 horse-power can be generated for eight months in the year, that is, during the flood season. During the four months of low-water the generating capacity will be only a little above 1,000 h.p.

After the power to be consumed in mechanical processes is deducted, a total of about 3,600 h.p. of power will be available for manufacturing purposes. The greater portion of the power generated will be used in the manufacture of mechanical wood-pulp, and the rest for making chemical wood-pulp and paper. During the low-water season the manufacture of mechanical pulp will be suspended, but as the mechanical pulp manufactured during the high-water season in the spring and autumn will be sufficient to supply the mill for the whole year, the average daily output of paper will not be decreased by this suspension.

The buildings of the power plant will be situated on the left of the dam, and the power house will be built above the recorded water-level of 1912 in order to avoid inundation during floods.

Power Plant.—The river banks at Nanantsun being of solid rock, the river bed at that point is undoubtedly of the same character, but as no actual drilling has been done, the possibility of an accumulation of broken stones in the river-bed and of crevices in the rock has still to be tested. Consequently it is impossible to state the required depth of the foundation for the dam and the quantity of cement needed to fill any crevices. According to the estimate of Messrs. Siemens (appended to this statement), the total cost will be about $2,480,000. Of this sum, the expense of building the dam and roller weirs will be about $1,700,000. This estimate, however, is an extremely conservative one, as another estimate puts the cost of building the dam at only $750,000. As to the cost of power generation, the estimate of Messrs. Siemens is 1.75 cents per kilowatt hour. If the cost of construction and equipment can be brought below $2,000,000, the cost of power will be only 1.55 cents per kilowatt hour.

Owing to the great efficiency of the newest-type of steam-turbine, some people were of opinion that the cost of power generation can be reduced by using steam-turbines instead of water power. Careful investigation of the facts, however, proves this view to be unfounded. The cost of generation would amount to at least 3.5 cents per kilowatt hour when the most up-to-date steam-turbines are used. The Shanghai Power Company, which has the advantage of large-scale production, charges 2.4 cents for every kilowatt hour of power used, and if the price of coal should rise, the cost would be still higher. Consequently it has been decided to utilize water power for the generation of electricity, for although it costs more in the beginning, it will prove economical in the long run.

Plans for the Paper-Mill

After investigation by experts, it has been decided to build the dam and power-plant at Nanantsun, on the Hsiaochi, while the paper-mill will be established at Wenchi, about 90 *li* from Wenchow, for the manufacture of wood-pulp and newsprint. According to reports by the staff of the Ministry of Industry, this arrangement offers the following advantages:

(1) As Hsiaochi and Tachi have abundant supplies of timber, raw material can be supplied at low cost, while liushan, a wood largely produced in the neighborhood, is particularly suitable for paper-making.

(2) The dam to be built at Nanantsun is capable of producing sufficient power for the mill, but roller weirs must be installed to avoid danger during flood.

(3) Wenchi is not far from the power-plant, and at the same time possesses the advantages of good water-supply and communication facilities, being on the Wenchow-Chuchow highway and linked by the river Tachi with the timber regions and by the Oukiang with Wenchow.

The question next to be decided was whether the paper-mill and pulp-factory should be built together or separately. It was advocated by some that the factory should be at Wenchow and the paper-mill in Shanghai the following reasons being advanced:—

(1) Shanghai is a place of comparatively greater safety, not easily affected by military movements.

(2) The operation of the factory will not be subject to disturbance for military reasons or liable to heavy taxes.

(3) It would be easier to obtain capital (if it should be needed) from Shanghai investors than in Wenchow.

In reply to these points, it was pointed out that the Japanese conflict in Shanghai in 1932 has seriously affected the faith in the complete safety of Shanghai. In Wenchow very few military operations have taken place since the establishment of the Republic, and only a small number of soldiers are now stationed there. As to taxes, those imposed on paper may also be imposed on pulp. In a word, Chinese industries cannot be completely centered in Shanghai, and investors should extend their fields of activity to other places. Both from the technical and economical point of view, the pulp-factory and paper-mill must be in the same locality for the following reasons:

(1) A pulp-factory and paper-mill established at the same place can enjoy the same cheap supply of power. There will be no waste of power, as more pulp can be manufactured during the high-water season and paper only made during the low-water season. A separate paper-mill in Shanghai would require another power-plant or current would have to be obtained from other sources. The expense would be much higher, owing to the higher cost of power in Shanghai, while a portion of the power generated at Hsiaochi would be wasted.

(2) The manufacture of newsprint differs from that of higher grades of paper in that it is made with about 80 per cent mechanical pulp and 20 per cent of sulphuric pulp, no other elements and no bleaching being needed. Consequently, in the United States, Canada, Norway, Finland and Japan, nearly all newsprint-mills are built near the pulp factories, for separation of the two would mean much additional expense. In China, where the competition of imported paper is very keen, we should aim to reduce the cost of production as much as possible, and this cannot be done with two plants established in different localities.

(3) In the manufacture of newsprint, the pulp must contain at least 97 per cent of water. If the two plants are not situated at the same place, the pulp must be first partially dried to save transportation expenses, and this means a lot of additional work and expense.

(4) In preparing sulphuric pulp, steam is necessary. Though a large quantity is needed during the first stage, only a small amount is required during the last few hours, and the boiler of the paper-mill can be utilized to supply steam if the two plants are situated at the same place. If, however, they are separated, additional equipment must be installed.

(5) The manufacture of paper and wood-pulp are similar in nature. If the two plants are situated in different places, many technical and administrative difficulties will be experienced, and the necessity of increasing the number of employees will naturally cause greater expenditure.

(6) A large amount of equipment, such as standpipes, machine-shop, laboratories, pumps, and water-pipes can be used in common by both plants if they are in the same place.

(7) Land values and labor costs are much higher in Shanghai than in Wenchow, while the water of the Whangpoo is much less pure than that at Wenchi, and needs to be filtered.

Consequently, on account of these seven reasons, it has been decided to establish the paper-mill and pulp-factory at the same place.

Financial Estimates

Overhead Expenses

Cost of construction of paper and pulp mills (including machinery freight and insurance)	$1,900,000
Cost of constructing power-plant (including concrete dam, steel sluices, turbines and machinery) . .	1,900,000
Land, buildings, reservoir	300,000
Total	$4,100,000

Manufacturing Expenses

	Annual Outlay	*Cost per ton of Paper*
Timber	$413,952	$45.84
Sulphur	35,640	3.08
Lime	5,280	0.46
Coal	108,900	9.43
Imported pulp, etc.	138,600	12.00

	Annual Outlay	Cost per ton of Paper
Machinery repairs	$80,850	$7.00
Labor	61,200	5.30
Salaries	48,000	4.16
Depreciation	(Reserve for depreciation will be set aside 10 years from now, when the reimbursement of the British Boxer Indemnity Loan is completed).	
Insurance	17,600	1.52
Freight (from Wenchow to Shanghai)	57,750	5.00
Miscellaneous	115,500	10.00
Total	$1,083,272	$93.79

Estimated Profit

The paper-mill will turn out 35 short tons of newsprint a day, and at 330 working days per year the annual output amounts to 11,550 short tons. The cost of production being as stated above, the annual profit of the mill is estimated according to the highest, lowest and average prices of newsprint during the last ten years, as follows :

(1) According to the highest price during the period ($334 per ton, the average of 1931), the annual profit will be $2,774,428.

(2) According to the lowest price ($186 per ton, the average of 1924) the annual profit will be $1,065,028.

(3) According to the average price of the past ten years ($237 per short ton), the profit will be $1,654,078.

Estimated at the present lowest market price, $194 per short ton, the profit will be $1,157,428, and this sum will be sufficient for the annual reimbursement of the British Boxer' Indemnity Loan.

The following table shows the price of newsprint in Shanghai during the last ten years, figures being furnished by the National Tariff Commission, of the Ministry of Finance :—

	Price per Ream	Price per short ton
1st quarter, 1923	Tls. 2.764	$209.15
2nd ,, ——	,, 2.765	209.23
3rd ,, ——	,, 2.672	202.19
4th ,, ——	,, 2.612	197.65
1st ,, , 1924	,, 2.495	188.79
2nd ,, ——	,, 2.480	187.66
3rd ,, ——	,, 2.453	185.62
4th ,, ——	,, 2.453	185.62
1st ,, , 1925	,, 2.808	183.35
2nd ,, ——	,, 3.300	212.48
3rd ,, ——	,, 2.908	249.71
4th ,, ——	,, 2.850	220.05
1st ,, , 1926	,, 2.742	207.49
2nd ,, ——	,, 2.775	209.48
3rd ,, ——	,, 2.605	200.53
4th ,, ——	,, 2.800	211.88
1st ,, , 1927	,, 2.908	220.05
2nd ,, ——	,, 2.917	220.73
3rd ,, ——	,, 2.885	218.31
4th ,, ——	,, 2.818	213.24
1st ,, , 1928	,, 2.675	202.42
2nd ,, ——	,, 2.817	213.16
3rd ,, ——	,, 2.917	220.73
4th ,, ——	,, 2.933	221.93
1st ,, , 1929	,, 2.967	224.51
2nd ,, ——	,, 2.955	223.50
3rd ,, ——	,, 2.887	218.46
4th ,, ——	,, 2.992	226.40
1st ,, , 1930	,, 2.233	244.64
2nd ,, ——	,, 3.433	259.78
3rd ,, ——	,, 3.658	276.80
4th ,, ——	,, 3.400	257.28
1st ,, , 1931	,, 4.092	309.64
2nd ,, ——	,, 4.125	312.14
3rd ,, ——	,, 4.333	327.88
4th ,, ——	,, 5.133	388.41
1st ,, , 1932	,, 4.000	302.68
2nd ,, ——	,, 3.900	295.11
3rd quarter, 1932	Tls. 3.700	279.96
4th ,, ——	,, 3.683	278.68
1st ,, , 1933	,, 4.995	270.00
2nd ,, ——	,, 4.732	256.09
Average ——	,, 3.138	237.45

Report of Siemens (China) Co. on Hydro-Electric Power-Plant

General Remarks.—In order to generate power for the proposed paper-mill near Wenchow, it has been planned to build a water-power plant on the Hsiaochi river, near the village of Nanan, about $2\frac{1}{2}$ kilometers above the point where the Hsiaochi flows into the Tachi.

The Hsiaochi river has a catchment area at the proposed site for the power-plant of about 1,200 square miles, or 1,200 by 1.61 by 1.61=about 3,100 square kilometers, and the average yearly rainfall is supposed to be about 2,000 mm. Under the climatic conditions in Central Europe, the evaporation for 2,000 mm. of rainfall would be (Keller's Formula) :—

$$h_v = 400 \text{ mm } \frac{h_n}{15} = 400 \frac{2000}{15} = 534 \text{ mm.}$$

As the average temperature is higher in the Wenchow district than in Central Europe, the evaporation will consequently be higher than calculated above. We will assume that the higher temperature causes an increase of the evaporation loss of about 20 per cent ; the evaporation can be assumed, therefore, at about 650 mm. per year. With the above figures, the yearly discharge of the Hsiaochi River is found as follows :—

Catchment area : 3,100 sq. km. = 3,100,000,000 sq. m.

$$h_a = h_n - h_v = 2.00 - 0.65 = 1.35 \text{ m.}$$

Discharge per year : Q=31,000,000,000 by 1.35=42,000,000,-000 cbm. The year having 31,560,000 seconds, the average discharge is :

$$\frac{4,200,000,000}{31,560,000} = 133 \text{ cbm/sec.}$$

This figure of the river discharge checks quite well with the actual measurements which are available for a period of about six months, so that it can be assumed that these preliminary measurements of the discharge quantities of the river give a sufficiently sound basis for the approximate calculations of the capacity and economy of the power-plant.

The measurements show that the water discharge of the Hsiaochi river varies considerably ; the lowest record during dry season being about 10 cbm/sec. whereas the severest flood ever known causes a rise of the water level of the river to about 14 meters. The exact quantity of water discharged at this high flood is unknown, and has still to be ascertained by investigations. It will amount to several thousand cbm per second.

Arrangement of Dam.—In order to create the necessary head for the turbines, a dam has to be erected across the river. The width of the river at the proposed site is approximately 150 meters, the banks being rocky and sloping up at an angle of about 45 degrees. The construction of a fixed concrete dam is impracticable, owing to the above-mentioned extremely high floods which occur in the Hsiaochi river. In case a fixed concrete dam of the necessary height as planned in the first instance be built, the high flood level would be raised so much by the dam that severe damage would be caused to fields and villages up river, and the power house would have to be raised rather high in order not to be flooded, so that its construction would be extremely difficult and expensive.

This fact has already been mentioned where it was stated that the inspection of the Hsiaochi valley revealed the imminent danger which back-water effects of a fixed dam of about 40 feet height constructed near the point "BM 6" (Nanan) might cause to the villages above that point. The local conditions call, therefore, for a movable weir construction which can be completely opened at times of high flood in order to keep the highest flood level at a reasonable height. We propose to use the simplest and most dependable construction for the movable dam in the form of four wide span steel roller weirs of about 35 meters span

each, which can be raised over the highest water-level ever to be expected by electrically driven machinery. The four roller weirs are supported by concrete piers. By these big roller weirs the flood-waves coming down the river can be safely controlled, and the water level before the dam can be regulated in order to ensure a safe and economical working of the turbines. This type of movable weirs has been installed in many rivers in Europe, and have proved their reliability for many years. The weirs are fitted besides the electric machinery with hand-drives, so that they can be operated, even when the electric supply fails.

One of the four roller weirs will be fitted with a damming leaf, which can be lowered and allows the surface water to flow over the weir in order to discharge, if necessary, drifting foliage, etc., which could choke the screen of the turbines. A light footpath-bridge connects the piers over the highest high-water level to support the shaft of the operating gear, and which forms at the same time a connection between the two banks of the river.

Power House and Machinery.—The power house will be erected adjoining the movable dam at the left bank of the Hsiaochi river. The power house contains in its lower part the chambers and tail-races for three water turbines. At the intake a screen and the necessary gear to close the turbine chambers will be installed. The floor of the generator-room has been placed over the highest flood-level in order to avoid flooding of the electric machinery. The turbines have a vertical shaft. It is proposed to instal for the time being only two Francis turbines of a water consumption of 31 cbm/sec. each and a maximum output of 2,600 h.p. each. The third unit can be added at a later date when the increase of power consumption justifies it.

With the records of river discharge available up to now, the two turbines can work with full capacity for about eight months of the year. During the remaining four months the turbines have to work with reduced capacity, whereas during about two months of the year one turbine has to be switched off entirely and only one turbine can work owing to lack of water. It has to be observed further that during the few days of the year of extremely high flood, the head available for the turbines and consequently the output will be reduced, owing to the rise of the water-level in the tail race, while during the short periods of catastrophal high flood (which, however, will only occur in intervals of several years), the head of the plant will almost drop to zero when all movable weirs have been entirely opened to let the flood-wave pass.

Considering all the above facts, the average yearly output of the power-plant based on the available records of the river discharge, can be assumed at above 18 million kilowatt hours per year.

The electric generators will be directly coupled with the water turbines and also the exciter dynamos. Of the latter, one will be provided for each generator. The voltage of the generators has been assumed with 6,600-volts in accordance with the regulations of the Nacoco.

A travelling-crane will be provided over the entire length of the turbine-room.

On account of the limited space at the site, we propose to place the switch plant and transformers on top of the engine-room. The high-tension transmission from the transformers to the paper-mill will be through an overhead line. At the site of the paper-mill a set of step-down transformers with the necessary switchgear will be provided in which the transmitted voltage will be reduced to a voltage suitable for the paper-mill motors.

Conclusion.—The preliminary data available show that it is possible to erect on the Hsiaochi river a water power plant capable of generating the energy for the operation of a paper-mill of the proposed capacity.

In the attached calculation of rentability, the approximate cost of energy generated in this water power plant has been estimated at about 1.75 cents per kw.h. As one kilowatt hour cannot be generated below about 3.5 cents in a modern steam-power plant, the proposed scheme of the water power plant must be considered as economically sound.

Japan and Manchuokuo

(Continued from page 486)

in fact we had to, for hesitation and delay meant a serious danger. But now that our Empire is placed on a solid and secure basis and immediate danger is over, we mean to submit this mass of incongruities to a sieving process so that we may retain the good and throw out the bad.

Our effort is being directed to establish harmony between our own civilization, with its ancient traditions, and the best elements of the western culture we have assimilated in modern times. To be sure, we shall not be able to do this in a short period of time; but, when it has been accomplished, we shall have something of which we may well be proud. A civilization purely Japanese, in complete harmony with the Occidental culture, will have been so smoothly established that no one will think that an effort at harmony had ever been made. Japan is not going to be westernized. She is developing her own destiny, culture and civilization.

Japan is a democratic country, as democratic as any in substance and more democratic than some known officially as democratic, if by this term we understand a form of government by popular representation, with equality of opportunity for all classes. Truly, the strength of our country lies in the essentially democratic nature of its various institutions. Talents are always recognized, encouraged, employed and given full opportunity to be of useful service to the community, and they are adequately rewarded. Radical propaganda may appeal to inflammable young minds and visionaries, but beyond that it is not going to have any chance. The soil and atmosphere of Japan are not congenial to the growth of extreme radical thought.

The Emperor is the source of all power. He is the fountain-head of all that contributes to the highest good of the state and the community. This is the spirit of our Constitution, but in exercising his power he is bound by his oath, made absolutely of his own free will, to consult the people. The Emperor governs the country in the spirit of democracy. To him, as the source of all power, everybody's chance of success is equal. There is no position in the Government constitutionally closed to a particular individual or a class of individuals. Given talents and opportunity a plain man can attain to any position under the Emperor.

What Interests America Most

(Continued from page 490)

result we find Republicans and Democrats voting in favor of or against certain issues regardless of whether such issues are fostered by the political party of their choice. This should, of course, bring into existence a revamping of the political parties on definite economic principles, instead of the present traditional principles, which in reality were germain to a former age and not to the present highly complex period of world economic disruption.

Of course, it is apparent to me, as a native American, that our politico-economic situation is involved with factors which differ from those of England and most European countries. In the latter there is a definite racial family psychology to deal with. In England and France, for instance, the racial and national characteristics have been molded by almost a thousand years of legislation. It is possible, therefore, to estimate with some fair degree of accuracy as to how an Englishman or a Frenchman will react to a given cause, but in America we have the British, the French, the Oriental, the German, the Italian, the Russian, Scandinavian, Pole, Jew, and other peoples in large numbers, gathered together in communities with their own language papers and their own home-country traits and prejudices, to contend with.

This heterogeneous population, combined with the vastness and varied climatic conditions of our territory, makes the task of readjustment by one plan, in the United States, as difficult as it would be to find a single plan which would be applicable for the economic readjustment of all of Europe.

The awakening of a new political consciousness, through the "New Deal" to which I have already referred, should do much to mold the thoughts of the American people into a new national unity, maintaining the advantages of their former individual liberty and eliminating the disadvantages of their present homogeneity.

The Irrigation Works at Sontay, Indo-China

In the immediate neighborhood of Sontay in Indo-China a pumping station has been put into service for irrigating about 24,700 acres of land, the necessary water being taken from the river Rouge. The plant is intended in the first place for providing the water required for the winter crop of rice during the irrigation period from December to May; the river is then at its lowest, falling at Sontay to 16½-ft. above sea level. In dry years, or when the rainy season starts late, irrigation has to be continued in June and July for the benefit of the summer crop of rice, which is harvested in November. The delivery head of the new pumping plant is about 16½-ft. and was fixed by the necessity of ensuring an ample supply of water to the rice fields situated more than 33-ft. above sea level, even when the river Rouge is at its lowest. Taking the average quantity of water required for irrigating the fields as 4.25 gals. per acre, the total quantity of water delivered is normally 105,500 gals. per min.

The pumping station is situated on the bank of the river, where it is protected by a dam which prevents the irrigated zone being flooded when the river rises. A canal about 26-ft. broad connects the river with the suction well of the pumping plant. The end of the canal, where it enters the river, can be closed by a sluice, and a grill prevents the entrance of any large solid bodies. The canal is constructed in reinforced concrete and is about 130-ft. long, with a cross section of 13 by 7-ft.; its bed lies 10-ft. above sea level. The canal is connected with the pump suction chamber by means of several openings.

The pumping station has two floors below ground level, the walls of which are constructed in watertight reinforced concrete and rest on a caisson with a surface 74 by 41-ft. The lower of these two rooms is occupied by the suction chamber already mentioned, where the suction pipes of the pumps are immersed in the water. The pumps are installed in the upper room. Above these two rooms, i.e. about 13-ft. above the floor of the pump room, is the machine room with the boiler house alongside.

The pumps deliver the water through a short length of pipe into a delivery canal, which is similar to the suction canal and leads to a large rectangular reservoir near the pump house. From this reservoir the main irrigation canal departs (Fig. 1). A valve, which can be operated from the machine room, is fitted between the delivery branch and delivery pipe of each pump. This allows each pump to be shut off from the delivery canal, in order that it may be overhauled while the service with the other pumps can be maintained. In order to prevent any back flow of the water if the pumps should suddenly stop for some unforeseen reason, a non-return valve is fitted at the canal end of each delivery pump.

Three single-stage vertical Sulzer Limax centrifugal pumps are installed in the watertight pump chamber. They were built in the St. Denis works of the Compagnie de Construction Mécanique Procédés Sulzer, Paris, and each delivers 35,250 gals. per min. against a head of 14¾-ft. when running at 158 revs. per min. and absorbing 195 h.p. (Fig. 3). To deliver the same quantity of water against the maximum stipulated head of 17¾-ft., the pumps have to run at 167 revs. per min. and then absorb 249 h.p. The suction pipe of each pump has an internal diameter of 5½-ft. and the delivery branch an internal diameter of 4-ft. Before being started the pumps are primed by electrically driven vacuum pumps.

Although it is not absolutely necessary to protect the pumps against flooding, it has nevertheless been considered preferable with this plant to install it in a watertight room in order that the pumps may be dismantled and overhauled without difficulty when the river is high and they are not required to work. In addition to that, the whole foundation of the pumping station is watertight and capable of preventing any infiltration of water when the river is at high level. Further, the pump suction chamber is subdivided by side walls into three suction cells, i.e. one for each pump. Means provided for shutting each of these cells separately and emptying it by means of one of the three drainage pumps installed for this purpose.

In the engine room three vertical condensing compound steam engines are installed, each developing normally 250 b.h.p., but capable of giving 315 b.h.p. The speed can be varied between 245 and 340 revs. per min. The steam engines drive the pumps through reduction gearing, to which they are coupled by flexible couplings. In addition, a 5-cylinder airless-injection Sulzer Diesel engine (seen in the foreground in Fig. 2) has been installed in the engine house. This engine develops 250 b.h.p. at 300 revs. per min. and drives by belt an alternator of 172 kw.

In the boiler house are three tubular boilers working at a pressure of 255 lb. per sq. in. and each with a heating surface of 1,240 sq. ft. They are equipped with superheaters, which in normal

Fig. 1.—Pumping Station of the Irrigation Works at Sontay, Tonkin. Main Reservoir and Mouth of Main Delivery Canal

Fig. 2.—Engine Room of the Irrigation Works at Sontay, Tonkin. In foreground a Five-Cylinder Airless Injection Sulzer Diesel Engine developing 250 b.h.p. at 300 revs. per min.; behind it the Vertical Steam Engines Driving through Gearing the Sulzer Centrifugal Pumps located in room below

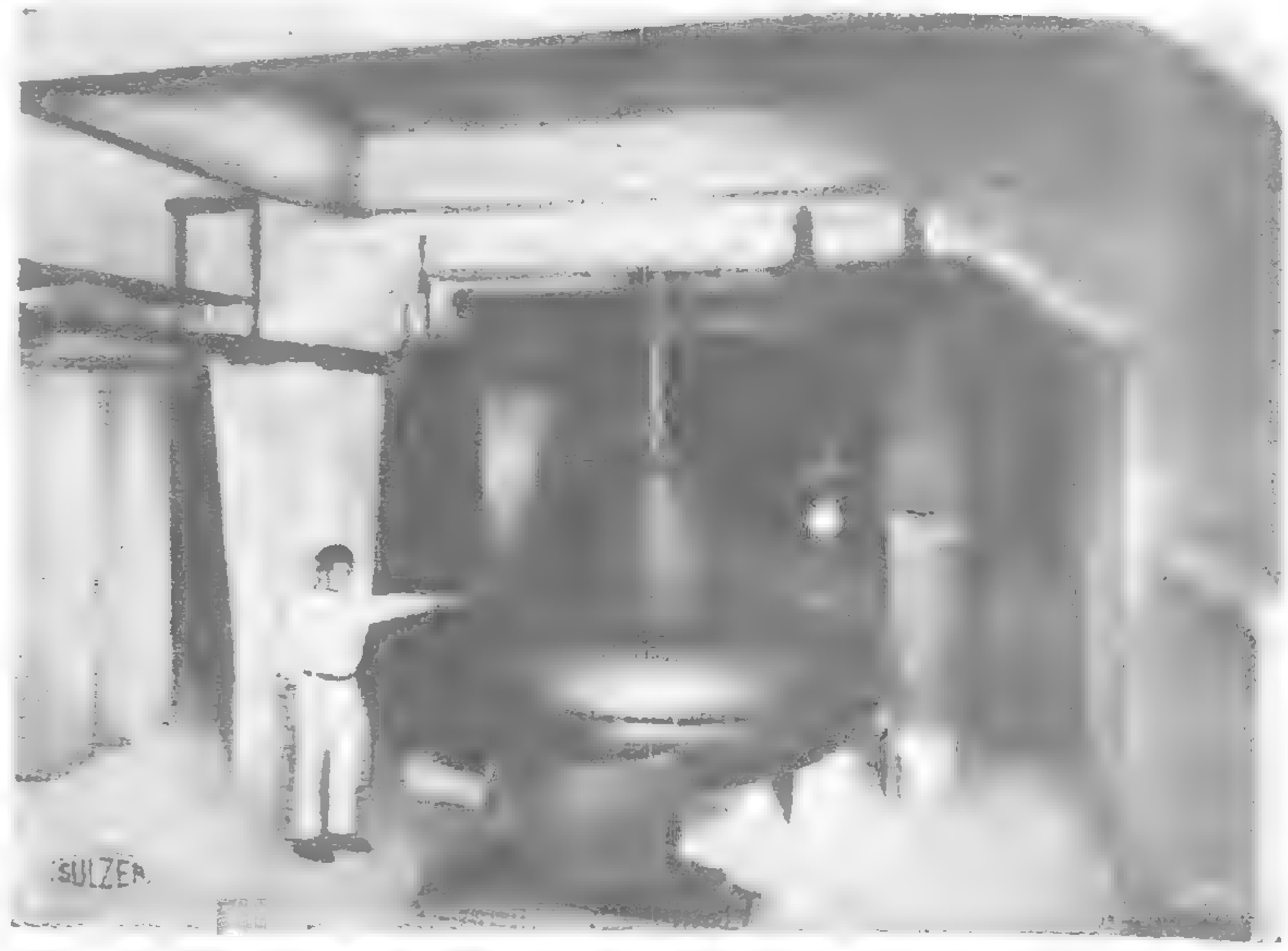


Fig. 3.—Pump room of the Irrigation Works at Sontay for Irrigating Large Tracts of Land in Tonkin; equipped with three Sulzer Vertical Centrifugal Pumps, each delivering 35,250 gals. per min. against a Head of 14¼-ft. and requiring 195 h.p.

service supply steam at 600 deg. F. A boiler with comparatively large water spaces was considered preferable, since boilers with a quicker rate of evaporation would be more difficult to attend by the unexperienced native labor available. Two boiler-feed pumps have been installed, one driven by a steam turbine and the other by an electric motor.

At times of low water, i.e. when the river has fallen below 33-ft. above sea level, and when no electric current is available for driving the drainage and boiler feed pumps, the plant is put into operation as follows :—A petrol engine drives one of the drainage pumps, which delivers the water into a settling tank, from where it is pumped by hand into the boilers. As soon as the boilers have developed some pressure, the feed is taken over by the turbo pump.

The main canal leading from the reservoir is 16 miles long. From it branch nine irrigating canals with a total length of 40 miles, and they in turn distribute the water into 260 trenches in the rice fields with a total length of 175 miles. The making of all these canals and trenches entailed the excavation of over 1¼ million cubic yards of earth. The breadth of the surface of the main canal varies between 6 and 15-ft. and the depth between 4½ and 8-ft. The fall varies from 4 to 6½ inches per mile.

The current for driving the electric motors of the auxiliary machines is supplied by a 65 kva generator driven by one of the steam engines.

The pumping station worked from the start to the complete satisfaction of the purchasers. In this case the irrigation does not merely give water to the land, as for example when watering grass land with ordinary river water, but a certain quantity of fertilizing mud is deposited, as for example in Egypt from the Nile. The muddy water of the river Rouge contributes greatly to improving the irrigated land, since the mud which is deposited prevents the ground from becoming exhausted by intensive culture.

Find Nickel in Japan

A promising nickel vein struck within the fortified zone of the Maizuru district, is expected to contribute much to the military industry of Japan. The owner is Yonekichi Heian, director of the Japan Nickel Industrial company at Higashidani-mura, Kawabe-gun Hyogo prefecture, who recently obtained permission to prospect from the fort authorities here.

Nickel deposits have been found extensively in such villages as Yakumo, Okadashimo and Okadanaka, Kasa-gun ; Higashi Hattamura, Iruka-gun, Kyoto prefecture ; and in the neighborhood of Takahama and Wada-mura, Fukui prefecture.

Mr. Heian, who is supported by the War Office, the Maizuru fort authorities, and the Maizuru auxiliary naval base, has enlisted the service of Senjo Yoshimoto, noted mining engineer of Osaka. They expect to begin actual prospecting soon.

Major-General Adachi, commander of the Maizuru fortified zone, remarks in this connection :

" I was quite unaware of the existence of a nickel vein in this district until Mr. Heian applied for permission to prospect. It is quite a good thing, considering the dearth of nickel in Japan.

" When you consider the facts that Japan depends almost entirely on imports for her nickel supply and that nickel goes into every conceivable article in the military and naval industry, the value of a nickel vein is apparent.

" Of course, its commercial value has yet to be established after actual prospecting, but according to Mr. Heian, the remarkable advance of smelting science will make it possible to make even ores of poor percentage a paying proposition."

A Java Rice Mill

The Na Eng Hoey, in Java, has had installed, through the Amsterdamsch Kantoor voor Indische Zaken (AKIZ), Batavia, a rice milling plant, comprising a rice thrashing machine and a complete rice mill supplied by Messrs. Kœrber and Naumann, Hamburg. The machines are driven by a Sulzer two-cycle Diesel engine developing 75 b.h.p. at 450 revs. per min., the engine room being located between the thrashing room and the room containing the mill. The power of the engine is transmitted to shafting by belt from a double-width pulley.

Since no rain falls for a long time at certain periods of the year in the district where the engine is installed, special attention had to be devoted to the cooling-water system. The hot cooling-water from the engine is pumped to a cooling plant, where the water trickles down over bamboo mats, the cooled water being collected in a concrete tank at the bottom. From there the water is pumped to a high-level tank of medium capacity and then flows to the engine under gravity. The two pumps are Sulzer centrifugal pumps, driven by belt from a second pulley at the end of the engine shaft. The cooling plant has proved very satisfactory even during the hot season.

One particular advantage possessed by the engine for this locality is its absolutely closed construction, since the air is laden with fine dust, which would soon adversely affect an engine of the open type.

For obtaining a good quality of rice it is very important that the engine should run at a constant speed. Here also the Sulzer engine with its precision governor has proved highly satisfactory, so that after a lengthy period of service the owners have written to testify to their satisfaction with the installation.

Flood Flow of the Yellow River

By S. ELIASSEN, Survey Department, Yellow River Commission

(The following paper was presented July 10, 1934, at the Annual Meeting in Tientsin of the Association of Chinese and American Engineers and was published in the September issue of the Journal of the Association.)

* * *

DURING travels to various parts of the Yellow River drainage area last fall and this spring the writer has made some investigations into last year's flood flow of the Yellow River, partly for the purpose of finding out to what extent the various parts of this remarkable river's drainage area contributed to what was probably the largest flood since 1887 or may be 1851. Before discussing the probable magnitude of the flashy flood wave which took place between August 7 and 14 last year a short description will be given of the flood as it affected the lower reaches of the river in order to let the reader get some idea of the ungovernable nature of this notorious stream when it has one of its crazy spells.

Mr. John R. Freeman in his paper " Flood Problems in China " has given a description of the floods in 1851 and 1887 as he compiled it from various sources. In 1919-1920 when he was in China as consulting engineer to the Grand Canal Improvement Board he made certain field investigations into the probable magnitude of the Yellow River floods at the place where the Grand Canal crosses the river. These investigations led him to believe that the river was not such an " ungovernable giant " as people thought it was. Had he had occasion to observe the river when it really was in flood he would most likely not have passed such a remark.

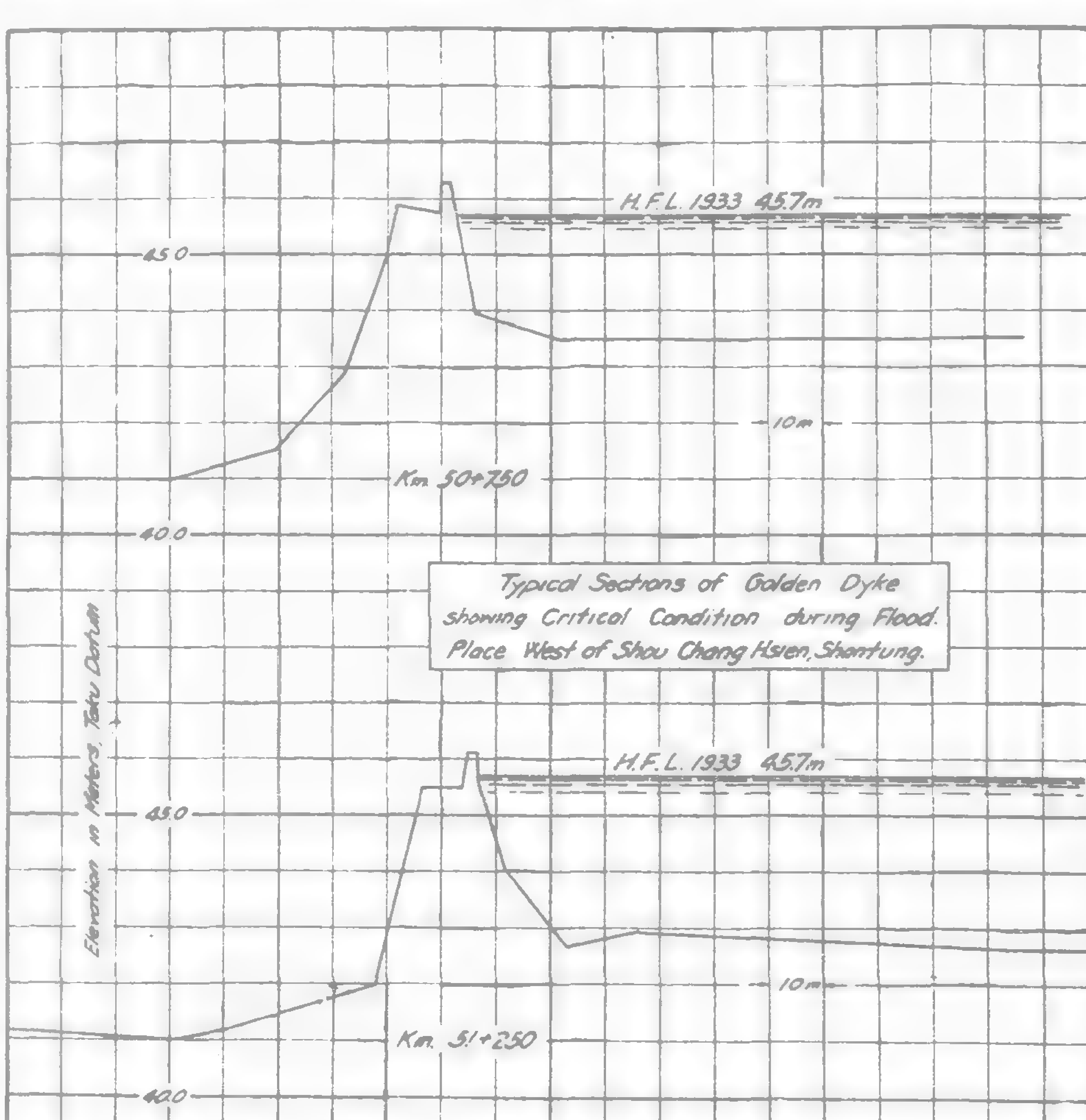
There is of course no telling if the river during the two years 1851 and 1887 had flows in excess of last year's. The only thing we know is that in 1851 the river changed its course from south to north of the Shantung mountains and in 1887 it broke its south dike not far upstream from Kaifeng and threatened, during the following two years, to re-establish a course to the south of the Shantung mountains. During the winter of the second year the breach was successfully closed and since then there have been no dike breaks of any serious nature upstream from the place where the 1851 disaster occurred. Downstream from this place, however, there have often been breaches, generally of the river's inner dikes especially in the Shantung section. At times the outer dike has also been broken, but without causing any general change of the course which the river has had since 1851.

Last year's flood, however, came perilously near to causing one of the river's notorious changes of course. Simultaneous overtopping and breaching of both the north and the south dikes in Honan and Hopei Provinces took place. But it seems that the breaching of both dikes at the same time formed a balancing effect on the river channel; and, as the flood wave was an extremely flashy one the breaches chocked themselves due to the excessive silt load which the water carried, leaving only the most downstream one on the north inner dike open. This was closed without much difficulty about two months ago.

The total number of dike breaches was about fifty, of which three very critical ones were on the south dike, two in Honan and one in Hopei. The south dike here is the only dike and if the river gets outside the dike it has a free run across the plain to take up a course south of the Shantung mountains again. As luck would have it, it did not happen. On the north side the river went right over the dike for a distance of about 15 kilometers.

The most upstream of the three south dike breaches was at the same place where the river changed its course in 1851. It was really not a dike breach, but the overflow of the relatively high ground caused by silt deposits from the 1851 flood and by sand drifts later. The water, however, found a way through a narrow low place and rapidly developed a wide channel pouring for a short while in great quantities down the former Yellow River bed. This flow caused great consternation in Hsuchow, a city on the Tientsin-Pukow Railway in north Kiangsu. Part of Hsuchow lies directly in the bed of the old Yellow River so there was real reason for alarm. But the water did not reach as far as Hsuchow. On the way down part of the flow became deflected towards the east into the lakes at the base of the Shantung mountains, and there was not volume enough for the rest of the flow to fill the wide, old river bed as far as Hsuchow. The flood subsided as rapidly as it had risen ; and after a few days the flow automatically stopped, being drawn back into the main channel again. The breach is generally referred to as the Lan Feng breach, named after the Lung-Hai railway station which is near.

The next and more serious breach was at K'ao Cheng Hsien, also in Honan, about 10 kilometers directly downstream from Lan Feng. Here the breach seems to have been caused by overtopping of a too low loop dike around a former dike breach. In general the south dike in Honan and Hopei downstream from Lan Feng proved to be too low, as the high water line which has been levelled to after the flood shows that the water everywhere reached level with the top of the dike. It was merely a question where the water would dig a hole and at K'ao Cheng a breach 200 meters long developed. But the sudden drop of the water level after the crest had passed prevented any great development of the breach and any definite change of course at this place. It did not take many days before the breach closed itself by the rapid deposition of silt on the berm in front of and on the ground outside the dike.



Typical Sections of Golden Dyke showing Critical Condition during Flood. Place West of Shou Chang Hsien, Shantung.

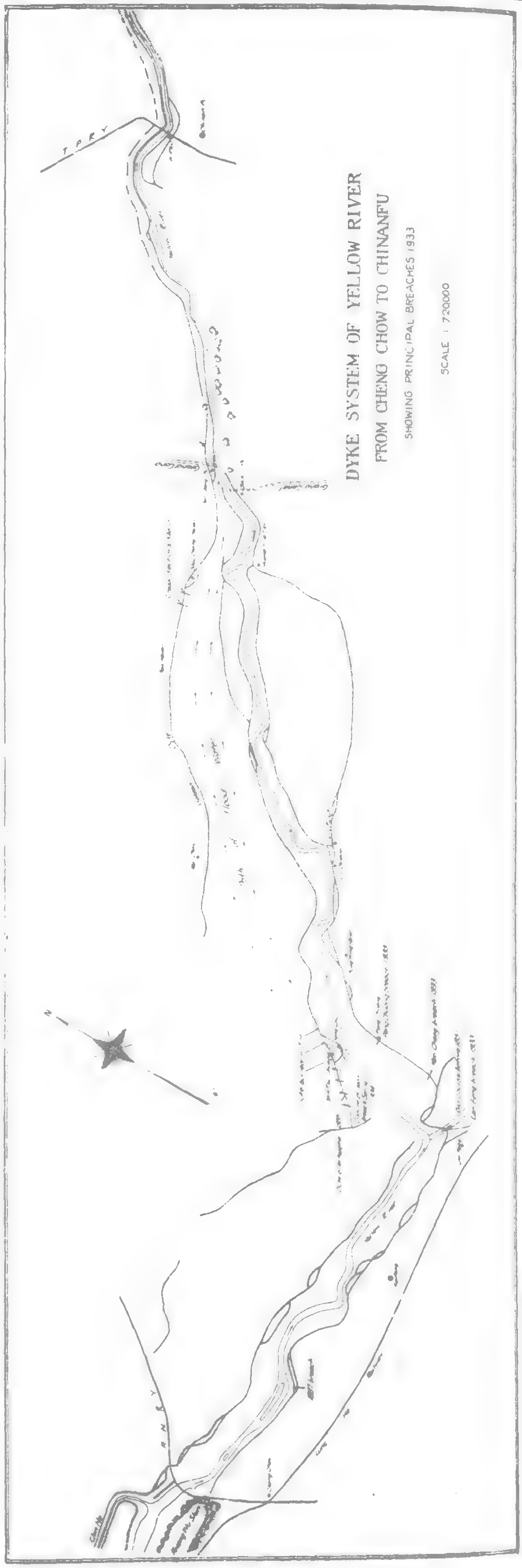
The third breach of the south dike, some say caused by burrowing animals, but unquestionably also caused by overtopping, took place 25 kilometers downstream from K'ao Cheng, at a place called P'eng Chuang. Similarly this breach, although considerably larger than the K'ao Cheng breach, gradually chocked itself and partly for the same reason. Both at K'ao Cheng and at P'eng Chuang, the river is far away from the dike, and there was not time for the water to develop a channel through this wide berm before the crest had passed and the river, as far as the south side was concerned, was confined again to its ordinary channel. Moreover, the breaches on the north bank, almost directly opposite, acted as a powerful draw in preventing the breaches from developing to a serious size. At times a wide berm has its advantages and this was one of them. As long as the present system of flood control has to be kept up this fact should not be overlooked.

But it was along the north, or what may be termed the river's inner dike, in Hopei Province, that the rest of the breaches took place. Here the river's flood defenses consist of a rather low inner dike, also with a wide flood berm in front. To the north of this dike there exist two other dikes, one upstream and one more downstream, both running at an angle to the inner dike and connected to it at a point downstream. Water which may escape out on to the plain through the inner dike becomes deflected by these dikes and is diverted back into the main river at the downstream end of the deflecting dike. The most upstream of these deflecting dikes comes into action if the north main dike becomes breached upstream from Lan Feng, and the water is led back again into the river at Lan Feng. This dike, however, is not very efficient. The downstream dike, called the Golden Dike is better built and maintained and leads the water which escapes through the north inner dike in Hopei back again into the river near the crossing of the Grand Canal in Shantung. Last year this dike barely saved the situation and prevented the river from breaking away across the plain to the north. It caught the out-rushing water and led it back into the river at a point 150 kilometers downstream near the crossing of the Grand Canal in Shantung. But the condition was extremely critical for a while as may be seen from the two appended cross-sections of this dike. Small dikelets were hastily thrown up to prevent overtopping. The flooded area between the inner dike and the Golden Dike was nearly 2,500 square kilometers. An idea of the detention effect on the flood flow of this area may be had from the fact that it took the water nearly one month before it reached a cresting stage at Lo K'ou where the Tientsin-Pukow Railway crosses the Yellow River. Ordinarily the flow takes less than two days to reach Lo K'ou from the Hopei section.

The maximum flow at Lo K'ou seems to have been just 10,000 c.m.s. It is rather surprising that the flow became so high when the three large breaches on the south bank are considered. Together these three breaches must have taken away between 8,000 and 10,000 c.m.s. from a flow which upstream from the Lan Feng breach probably amounted to 22,000 or 23,000 c.m.s. A reason for the rather high flow at Lo K'ou may be that the flow accumulated at the junction of the north inner dike and the Golden Dike due to the non-existence of a proper channel to lead the water more gradually back into the main river. Such a channel probably developed quickly after the water had accumulated and thus suddenly released more water than otherwise would have been the case.

In spite of the high flow which issued back into the main river the whole lower reach from the crossing of the Grand Canal to the mouth stood the heavy flow very well. It was the highest flow on record for this section and it speaks well for the Shantung river officials that no breaches occurred. Inr ecent years the former kao liang "fish scale" protections have been largely replaced by stone protections and the superiority of the latter was amply demonstrated by this flood. True, a good deal of damage was done to many of the protections; but the main thing is that they held the river to its course. The flood has deepened the main channel much; and after the damage to the protections has been repaired the river will be in a shape to take floods even larger than that experienced last year and this is necessary as the work of raising the dikes and the extra protection work which is now going on usptream will force a larger flow of water through the downstream section than was formerly experienced when dikes upstream always used to break during a more-than-ordinary flood.

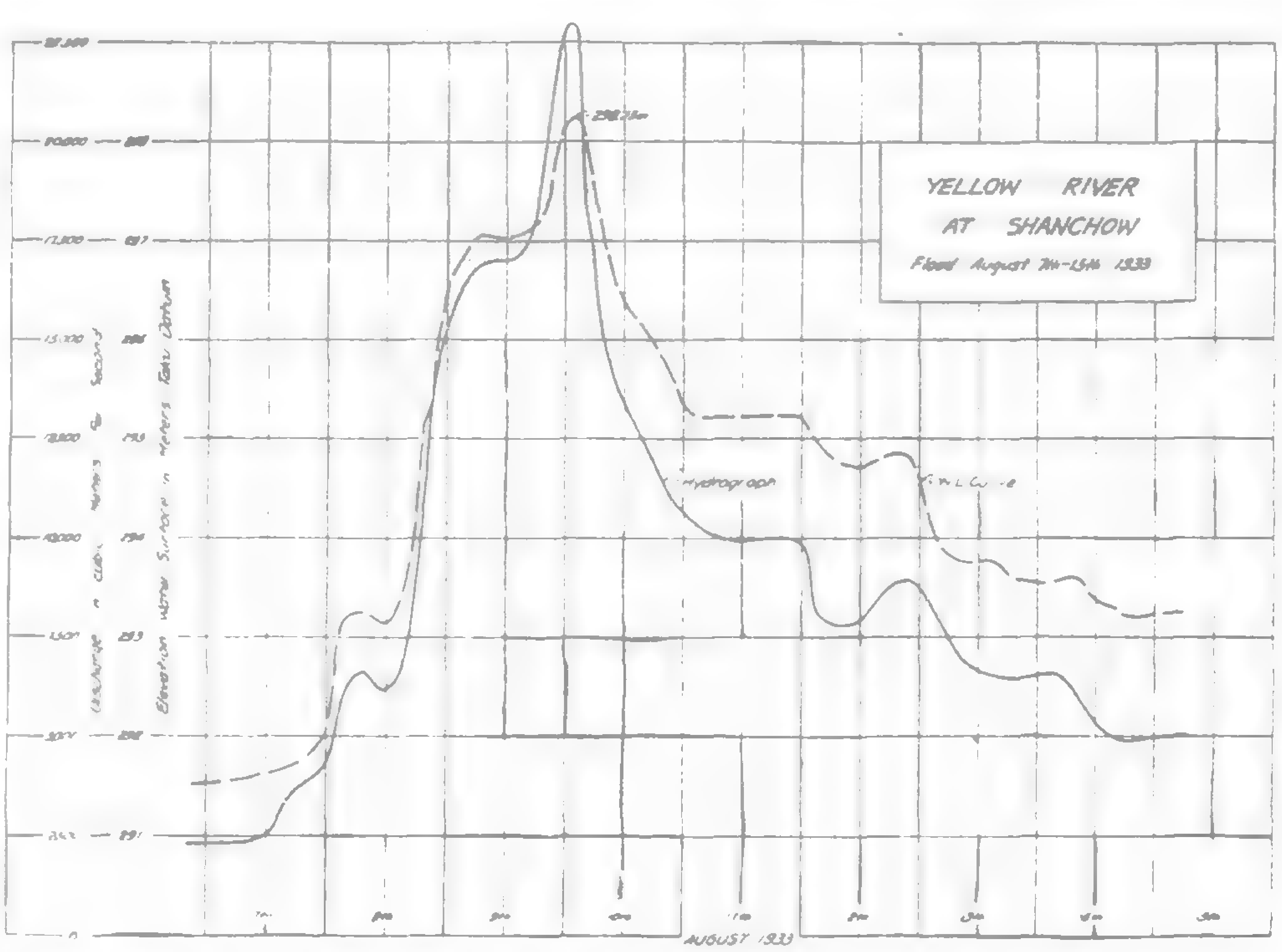
In Honan and Hopei the dike breaches last year were caused by overtopping. The river went from 0.5 to 1.0 meter over the top of



the three meter high north inner dike and partly buried it in silt for a distance of almost 12 kilometers. For a distance of two kilometers the dike was completely buried. Only two rows of trees showed where the dike line formerly was. This dike is being rebuilt.

The dikes downstream from Lan Feng in Honan and Hopei were probably built after the river's migration north in 1851. They have not been tested for a major flood until last year and then found lamentably too low. When originally built these dikes were set back from the river course from 5 to 10 kilometers, the distance being farthest upstream. Ordinarily the summer's flood water does not reach even to the foot of the dikes.

The tendency for the Yellow River water surface to be higher along the main channel than on the berm if this is flooded, is very strongly marked. A cross-section of the river course shows that the transverse slope of the water is from 1 : 3,000 to 1 : 5,000 from the main channel across the berm towards the dikes. The reason for this is due partly to the velocity head being much greater in the main channel than on the berms and partly because the water flowing on the berms does so in a diagonal direction due to the longitudinal slope of the river course as a whole and to the transverse slope of the ground towards the dikes caused by silt deposition on the berm, which always is heaviest near the main channel. Water soaked into the ground and also tied up with the settled silt probably also has some effect towards establishing the transverse slope. If the distance to the dike from the main channel is six kilometers it is quite possible for the water surface in the main channel to be from 1.0 to 1.8 meters higher than at the dike, if a cross-section line is considered drawn at right angles to the main river course.



But during a major flood this condition becomes less marked due to the berms being flooded quite deeply and the effect of the diagonal surface slope less marked. It may also happen that the river during the flood changes the position of the main channel over to one side. If no consideration has been taken of these possibilities surely the dike will be overtopped. The dikes are now being raised to take care of such possible happenings.

Upstream from Lan Feng the dike is very old. The river has meandered from one side to the other and through centuries tested every part of the dike system. Now this is high enough practically everywhere and in recent years much work has been done towards building an effective stone protection for the dikes. It was therefore possible to hold the river to its course along the stretch from the Peiping-Hankow Railway bridge down to Lan Feng. Much damage was done to the protections, but they held. This spring the protections are being repaired and the dikes heightened somewhat where found necessary.

Opinions have been expressed that the river section immediately downstream from Lan Feng is the river's natural deposition place for silt, and that the river tends to choke its channel here during a very silty, high freshet thus sending the water over the top of the dikes. Until further examinations have been made of the river's action in this locality (this is now going on) the writer will refrain from expressing an opinion on this matter. The scour and deposition action of the river is so complex that it is impossible to say what would happen, for example, if the dikes along this part were set closer together. Experiments in hydraulic laboratories in Germany have been conducted and are being continued to find out more about such actions of the river during flood which can be observed in nature with extreme difficulty if at all.

The destruction caused by this flood was a calamity of the first magnitude. Remarkably little was said about it in the newspapers even at the time it occurred, and practically nothing later. Only those who have travelled through the areas visited by the flood will have gotten an idea of the disaster. Everywhere one sees houses buried to the roofs in silt. A few villages on the north bank have been completely buried in silt. To-day most of the people in the stricken districts live in improvised buildings. Some have had the courage and optimism to rebuild ; but many still wander aimlessly about amongst the wreckage, living in the poorest of temporary shacks. Remarkably enough the population with the aid of relief organizations did manage, some way or other, to get their winter wheat sown and as the harvest this spring has been well above the average in most places the coming autumn will probably see a more vigorous reconstruction of the devastated villages. What the loss of lives was may never be known accurately. The official figures place those who were drowned, buried, and wounded at 18,300. The flood losses in the three provinces of Honan, Hopei, and Shantung have been estimated at 232 million dollars. The total area affected by the flood was about 9,000 square kilometers with over 3,000 villages destroyed and more than 2,500,000 people rendered destitute. Just where the worst flooding took place the country is densely populated and this accounts for the large loss of life. Any rescue work in the flooded area during and immediately after the disaster was almost impossible owing to the deep, liquid, sticky mud which takes weeks to dry out sufficiently for any communications to be re-opened.

The above-mentioned figures will give an idea about the destruction caused by the river during a heavy flood even if it does not change its course as in 1851. If such a thing were to happen then the figures mentioned here would become very small in comparison.

The Flood Flow of the Yellow River Last Year

Previous writers on the flood flow of the Yellow River have estimated it at 8,000 or 10,000 c.m.s. The Peiping-Hankow Railway officials when asking for competitive designs for a new railway bridge in 1921 gave, if the writer remembers correctly, 18,000 c.m.s. for the maximum flood flow as the required figure for design. The writer previously estimated it at about 15,000 c.m.s. based on gaging records taken at Shanchow in western Honan.

The low figure of 8,000 to 10,000 c.m.s. has been based on gagings taken in Shantung by the former Grand Canal engineers and partly by the engineers of the former Chihli River Commission who for a couple of years had a gaging station at Lo K'ou near the Tientsin-Pukow Railway bridge. However, the lower section of the river is a poor place for getting the correct idea of the river's maximum flood flow as this invariably, when it is serious, becomes much reduced due to upstream dike breaches. Below the crossing of the Grand Canal the river has up to now never felt the effect of a really serious flood. The fact that the railway engineers upstream selected such a high figure as 18,000 c.m.s. only shows that their observations of the river which have been kept up since 1902 have led them to believe that the river can have a much higher discharge then 10,000 c.m.s.

The same thing holds with regard to the silt content. A value of six per cent by weight has been observed in the Shantung section and an estimated 10 per cent as a maximum is no criterion for the silt load which the river actually can carry during really heavy floods.

Before the flow reaches the lower sections of the river in Shantung much of the silt load which the river has carried upstream has become dropped on the berms or in places where the river overflows. Last year the river relieved itself almost completely of its silt burden in the inundated areas before it flowed back into the main channel. The writer has made silt observations on some of the most important tributaries to the Yellow River and found that these can carry up to 50 per cent by weight and that for several days on stretch the silt load can be more than 30 per cent by weight. The term " liquid mud " is the correct term for the flood flow of these rivers.

On the other hand observations, also conducted by the writer, on the Yellow River in Sui Yuan show that only seldom does the silt content there exceed two per cent by weight. During the last three or four years the maximum has been five per cent, a startling contrast to the Shanchow gaging station in western Honan Province where up to last year 25 per cent and 30 per cent have been measured, and during last year's flood 39 per cent by weight was measured during the rise of the main flood wave. During the crest or immediately after the crest no observations were taken and this figure is perhaps not the maximum. At Sui Yuan during the flood last year the silt percentage was stated not to have exceeded three per cent. The conclusion of course is that the silt mainly comes from the Shansi and Shensi Provinces and also a part of Kansu where this province is a part of the Wei River drainage area. But further isolation of the silt contributing area is necessary before any such thing as erosion control works can be started. It is hoped to get important records on this during the next two years.

Last year's flood was fairly well observed at Shanchow where the Honan Provincial Conservancy Bureau under Mr. Y. C. Chen a returned-student from America, had placed engineers to observe the flow. Although they did not get a measurement just at the cresting stage of the river, as this occurred during the night, yet sufficient measurements were taken during the flood to make certain that the maximum flow as deduced from a plotted discharge rating curve must have been between 22,000 and 23,000 c.m.s. The measure silt percentage by weight on August 9 during the rising period was as already mentioned 39 per cent.

The river began to rise rapidly from a flow of about 2,500 c.m.s. on the morning of August 7 and rose in three distinct waves, the last culminating during the night between the 9th and the 10th of August reaching the figure mentioned above. On the evening of the 14th the river was down to an almost normal summer high water of about 5,000 c.m.s. The drop in discharge during the forenoon of the 10th at Shanchow was especially marked. On the whole it was an extraordinarily flashy flood considering the large drainage area of the river, which above the Peiping-Hankow Railway bridge has an extent of about 730,000 square kilometers or about 275,000 square miles. It behaved like a small flashy river having a drainage area of $\frac{1}{10}$ the size. And for all practical purposes the flood developed from an area only $\frac{1}{4}$ of the area of the whole river.

The rapid drop of practically 2.0 meters during a few hours after the passing of the crest has been commented upon to the writer by several observers of the flood. The railway engineers at the Peiping-Hankow Railway bridge remarked on it and thought it was due to the downstream breaches. The river engineers working frantically to protect the dike system near Kaifeng were both greatly surprised and relieved at this sudden drop. At Lung Men, 150 kilometers upstream from the confluence point of the Yellow and Wei Rivers, the people told the writer that during the flood the river " lost its bottom " as the water level suddenly droped 10 feet.

Although the river flow itself decreased very suddenly on the morning of August 10 there can also be no doubt that bed scour played a great part in accelerating this action. The fact is that the river after the flood has lowered its bed from 1.5 to 2 meters the whole way from the Yellow River bridge of the Peiping-Hankow Railway nearly to Lan Feng. At Lung Men the river bed has also been scoured an equal amount. But there are places where the river is said to have raised its bed as at Pin Ming Hsien not far upstream from the confluence of the Yellow and Wei Rivers and also downstream from Lan Feng in the section where the breaches took place. Here, however, the condition is complicated by the breaches and it is difficult to draw any conclusion as to whether the river tends to have definite depositing places for silt, or definite debris cone formations.

At Shanchow where the hydrometric measurements of the flood were taken the river bed is composed of large and small boulders usually overlaid by a shallow layer of river silt. During a flood, even if serious, there cannot be any marked change in this section. The actual characteristics of the flood are thus well reflected in the appended water level and hydrograph curve.

Action of Tributaries During Flood

When a flood of the Yellow River occurs, one of the first questions one wishes to ask is: " Where did all the water come from ? " Fortunately there exist approximate data of the flow of some of the more important tributaries and also data from a point upstream in the province of Sui Yuan, at the intake of the Min Sheng irrigation canal on the Yellow River. The writer has gradually collected flood data from these places. Important points where no records were kept he has visited personally and made an estimate of the flood there, its magnitude and the time at which it occurred. Due to the lack of rainfall data it has not been possible to form a more considered judgment of those rivers for which actual observations of the flood do not exist.

The results of the studies have been brought together in a table. No great accuracy is claimed for this table ; but the figures have been brought together more to show in a relative way how the different parts of the Yellow River drainage area contributed to the flood. The following remarks are offered with regard to the characteristics of the various drainage areas mentioned in the table.

Flow from Area between T'ung Kuan and Shanchow

This area on both sides of the Yellow River has an extent of about 3,000 to 4,000 square kilometers. The flow period has been estimated partly from the rainfall period at Shanchow and partly from information obtained from a visit to several of the streams. None of these streams which the writer saw, except the one at Shanchow, showed signs of having been in heavy flood and inquiry on the spot confirmed this. The flow passing Shanchow from this area has been estimated at 300 c.m.s. It may have been more; it may have been less. The figures have been put down merely to show that the flow from the area was not heavy and did not contribute materially to the Yellow River flood.

The Wei Ho System

The Lo Ho.—The drainage area of the Lo Ho is from 24,000 to 25,000 square kilometers. The flood flow from this river was well observed by the engineers of the Lo Ho Irrigation Bureau and is thus definitely known. The observed maximum flow was 2,500 c.m.s. at a point 70 kilometers upstream from the confluence with the Wei Ho. When passing Shanchow this flow had been reduced to 2,000 c.m.s. on account of the storage and detention effect on the wide Wei Ho and Yellow River valleys before arriving at Shanchow. A 16 hour interval has been assumed between the point of observation and the time when the flow reached Shanchow.

The Lo Ho records have been courteously supplied by Mr. S. T. Sun, chief engineer of the Lo Ho Irrigation Bureau.

The Ching Ho.—The drainage area of this river is about 38,000 square kilometers. It is without doubt the greatest individual flood carrier and silt carrier, not only of the Wei River system, but of the whole Yellow River system. During the construction of the Wei Pei irrigation project in 1931 and 1932 the writer had occasion to investigate this river and conduct hydrometric work on it. According to his studies this river may have a maximum flow of 16,000 c.m.s. Silt contents of 48 per cent by weight were observed and at one time 51 per cent. During early summer, summer, and early fall the silt content often went above 30 per cent and would stay above 30 per cent for several days. A feature of this river is that it will rise to full flood height in a few minutes accompanied by a thunderous noise which can be heard for many kilometers. The writer has personally observed a 10 meter rise in less than 10 minutes.

A fairly reliable rating curve has been established for this river and the maximum flow which occurred last year has been judged from this rating curve to be about 12,000 c.m.s. Gage readings were taken of the water level during the whole flood period by the Ching Hui Irrigation Bureau's engineers and courteously supplied the writer by Mr. C. Y. Liu, its chief engineer. The results obtained are not in error very much. The time taken for the flow to reach Shanchow has been estimated to be 26 hours.

The Ching Ho which enters the Wei Ho about 130 kilometers upstream from the latter river's confluence with the Yellow River drains the eastern part of Kansu as well as a part of western Shensi. Its drainage area perhaps contains the largest individual loess deposit in China. The lofty Liu Pan Shan mountain range forms its western boundary and the heavy convective precipitation caused by this mountain range when easterly, rain-bearing winds sweep over Shensi and eastern Kansu seems mainly responsible for the heavy floods of this river. The vast loess deposits which during heavy rains are readily eroded are the main cause of the heavy silt load. The Ching Ho drainage area is also very fan-shaped, a factor which promotes a high concentration of the run-off.

The Wei Ho.—The drainage area of the Wei Ho, apart from its two tributaries, the Lo Ho and the Ching Ho, is about 59,000 square kilometers. Of this area the northern slopes of the Ching Ling mountain range flanking the Wei Ho valley on the south amount to about 14,000 square kilometers and the upper, mountainous Wei Ho watershed in south-east Kansu to about 27,000 square kilometers. The rest lies to the north of the Wei River and is mainly loess country. This latter area does not usually contribute materially to the Wei Ho floods except perhaps the most upstream branch, the Chien Kan Ho, with its source in Kansu. It is an area noted for its drought and famine conditions showing that the topography is not very favorable to much precipitation. However, cloud bursts do occur during the summer, at times causing a flashy run-off of the few streams draining it.

The northern slopes of the Ching Ling mountain range seem more favorably located as regards precipitation. On the whole, rainfall to the south of the Wei Ho is considerably more than immediately to the north. Observations to this effect exist. The Ching Ling tributary area sheds water frequently and readily during the summer ; but being a narrow strip along the Wei Ho valley its numerous streams run-off progressively one after the other and will cause a prolonged, but not very intense flood crest at the mouth of the Wei Ho where it enters the Yellow River. The flow is also relatively clear and to a certain extent offsets the heavily silt-laden flow coming from other parts of the Wei Ho watershed.

It seems that the most important floods of the Wei Ho, when not considering the Lo Ho and the Ching Ho, come from the mountainous fan-shaped area most of which is situated in Kansu. In common with the Ching Ho, precipitation must unquestionably be heavy during easterly, rain-bearing winds. Last year it seems to have contributed by far most of the water and also the silt which the Wei Ho brought into the Yellow River. The mountainous, fan-shaped form of this area promotes a rapid, highly concentrated run-off and the flashiness of these floods resembles very much those of the Ching Ho. From the place in western Shansi where the Wei Ho leaves the mountains to its confluence with the Yellow River is a distance of about 300 kilometers. It is a broad, flat, sloping valley where the river meanders over a strip of ground up to five kilometers in width. On this wide area the flood flow becomes considerably reduced before it reaches the Yellow River. The flashiness of its flow as it comes out of the mountains also becomes ironed out to a certain extent.

The water levels of the Wei Ho were observed only at one place during the flood of last year, namely at Hsien Yang located about 150 kilometers upstream from the Yellow River. No measurements of flow were taken. The maximum flow of the river, however, is known approximately and flow, for stages other than the highest, have been estimated as well as possible, taking account of the flow which came from other parts of the Wei Ho area. Thus where the Wei Ho leaves the mountains in western Shensi a survey party has been working on reservoir studies for flood control and this party has computed the flood flow and obtained the time of its occurrence at this upstream point. However, the estimate of the Wei Ho flood last year cannot be anything but a very approximate one, the Hsien Yang gage records and the cross-section of the river there being the main clue. For its two main tributaries, the Lo and the Ching, the flow is much better known and therefore considered separately as previously dealt with.

The Hsien Yang records show that the Wei Ho floods occurred in two distinct waves of about equal magnitude, the last being, perhaps the larger. Combined with the flow entering the river downstream from Hsien Yang the two crests have been taken to be 4,000 c.m.s. and 4,500 c.m.s. respectively. It should be noted that the last and larger flood wave combined with the Yellow River flow about 60 hours after the main crest had passed and merely prolonged the falling of the flood some hours without causing any marked rise of the Yellow River itself. The first wave, however, seems to have reached the Yellow River just at the time of the passage of the flood crest of the Ching Ho, the Fen Ho, and the flow coming from the very upstream Yellow River watershed. This wave of the Wei Ho was probably not less than 3,000 c.m.s., but not more than 6,000 c.m.s. A figure of 4,000 c.m.s. has been used. At Hsien Yang the flow could scarcely have exceeded 3,000 c.m.s. For tributary inflow downstream 1,000 c.m.s. was added.

Considered as a whole there can be no question that the Wei Ho system including the Lo Ho and Ching Ho is the main offender with regard to the Yellow River floods. Flood control, if practicable, of the main tributaries of this system, ought to go a long way towards lessening the dangers caused by the Yellow River floods in the diked reaches.

The Fen Ho

The Fen Ho which drains central Shansi has a watershed area of from 38,000 to 40,000 square kilometers. Its shape is very elongated except the most upstream part which is fan-shaped. The Fen Ho floods, although locally serious, do not seem to be particularly so when considering their effect on the Yellow River. The silt which the water carries during freshets is a bad feature although not as bad as from the Wei Ho system.

A preliminary study which has been made of the flood flow of this river just upstream from its confluence point with the Yellow River shows that as a maximum flood condition the Fen Ho will probably never contribute more than 3,000 c.m.s. to the flow of the Yellow River. In most years it is much less than this and during the flood of last year, the maximum flow entering the Yellow River was between 1,500 and 2,000 c.m.s. It has been taken as 1,800 c.m.s. and seems to have reached the main river just in time to make up a part of the highest flood crest. At T'ai Yuan Fu the Fen Ho Conservancy measured the flow of the Fen Ho and found the cresting flow to be about 2,200 to 2,300 c.m.s. The flood, however, was not so large near the confluence point with the Yellow River 400 kilometers downstream from T'ai Yuan, even with the addition of inflow from the intervening area, as much overflow with a consequent reduction occurs on the flat bottom lands of the Fen Ho valley similar to those of the Wei Ho valley in Shensi. The elongated shape of the Fen Ho drainage area is in itself a guaranty that no very great floods can ever develop from it.

Flow from the Yellow River Area Between Pao T'ou Chen in Sui Yuan and T'ung Kuan in Shensi

This area has an extent of about 140,000 square kilometers and lies chiefly in the Shansi and Shensi Provinces on both sides of the Yellow River. Its northwesterly part in northern Shensi is said to be grass and steppe country. On the Shansi side it is highly mountainous with a considerable amount of loess deposits in the valleys. As a whole the shape of the area is somewhat elongated, but there are several large individual drainage areas of a distinctly fan-shaped character such as the Wu Ting Ho entering the Yellow River from the west with a drainage area of nearly 25,000 square kilometers. Most likely these larger areas can have serious flood flows. As no investigation has been made of the hydrographic character of this part of the Yellow River drainage area it is too early to pass any opinion on the relative flood producing importance of these individual drainage areas. Their total effect, however, can be observed at some point upstream from the confluence point of the Fen Ho, as at Lung Men where the Yellow River leaves the mountain area and issues forth on the flat plain between the mouth of the Wei Ho and Lung Men.

During an inspection trip to Lung Men the writer had occasion to look into the flood flow of the Yellow River at this point. From a cross-section taken at the place he came to the conclusion that the river must have had not less than 10,000 c.m.s. during the flood of last year. The time of occurrence of the crest was obtained. As about 2,000 c.m.s. came from the Yellow River area upstream from Pao T'ou Chen it leaves about 8,000 c.m.s. as the maximum flow from the area under consideration. The time of cresting was fortunately such as not to make an exact synchronism with the flow from the Wei Ho system or a much more violent flood on the lower Yellow River would have taken place. The cresting flow passed off about 16 hours before the main flood wave from the Wei Ho

arrived. From information, a second but smaller flood came from the area about one and a half days later.

That these floods came and went with extraordinary rapidity can be gaged from the saying of the people that, "The river suddenly lost its bottom," meaning that the water subsided very rapidly.

The river bed at Lung Men is composed of fine sand, a material which scours readily. A comparison of some photographs taken before and after the flood shows that the river bed for the same low water discharge is now from 1.5 to 2 meters lower than before.

There are no previous gaging records of any kind from the Lung Men locality. The place is an important one in the investigation of the hydrography of the Yellow River as records from this place will enable the investigator to separate the flow coming from the area under discussion from the Fen Ho and the Wei Ho flows. With a station also at Pao T'ou Chen the flow is completely known and the Yellow River Commission has recently established hydrometric stations both at Lung Men and near Pao T'ou.

Flow from the Yellow River Upstream from Pao T'ou

The writer has had an opportunity of gaging the flow of the Yellow River in Sui Yuan near Pao T'ou Chen while in charge of the construction of the head works of the Min Sheng irrigation project, during the spring and summer of 1930, for the China International Famine Relief Commission. The observations were continued by this Commission during 1931 and 1932. A fairly reliable relation between river heights and discharge has been established. Last year only river heights were observed and silt records taken. These observations show that the flow which came from the upper river reached a maximum towards the end of July. Between August 2 and 10 the flow was very steady at about 2,300 c.m.s. For the lower river this flow has been reduced to 2,200 to allow for any losses which may have occurred on the river channel to Shanchow, a distance of 900 kilometers. The silt percentage was stated to have been less than three per cent by weight during this period. There cannot be any great error in these figures.

From the writer's investigations it seems that the maximum possible flood from the whole drainage area of the Yellow River upstream from the Min Sheng irrigation canal's intake 20 kilometers below Pao T'ou Chen in Sui Yuan cannot be in excess of 5,000 c.m.s. and is probably less. As mentioned before during the four years' observations on silt an isloated five per cent has been observed in 1932. The records of the flow of the Yellow River at Sui Yuan and also the information about the Fen Ho flood flow last year at T'ai Yuan has been courteously supplied by Mr. O. J. Todd, chief engineer of the China International Famine Relief Commission.

Conclusion

It will be seen that as far as this particular flood is concerned, the Ching Ho, of the Wei River system was the worst offender with the drainage area between Pao T'ou Chen and Lung Men coming second. The action of the Fen Ho and the rest of the Wei Ho were relatively small in comparison. With regard to the Lo Ho in Honan entering the Yellow River from the south downstream from Shanchow with a drainage area of 19,000 square kilometers, and the Chin Ho, entering the Yellow River from the north 12 kilometers upstream from the Peiping-Hankow Railway bridge and with a drainage area of 12,000 square kilometers, it seems that they did not have heavy flows during the main flood period of the Yellow River last year. The Lo Ho may be capable of a flood in excess of 4,000 or 5,000 c.m.s. but the Chin Ho can scarcely have a flow in excess of 2,000 c.m.s. But on August 23 last year, well after the main flood had passed, the Lo Ho did have a serious flood.

The extremely flashy flow of the Yellow River tributaries and their tendency to be in flood nearly at the same time; and also the fact that they are nearly all mountain streams brings up the point forcefully as to whether it would not be possible to control the flood on the main river by a system of detention basins on the tributaries. An investigation into this possibility is being conducted at present. The most serious problem to be solved in making such a plan possible, will be the silt difficulty. A discussion on this is beyond the scope of this paper and besides it opens up a multitude of questions which cannot readily be answered, due to lack of data.

Minimizing soil erosion is one of the most important, but also most difficult steps towards the control of the Yellow River floods. It is quite evident that if the amount of silt brought into the river can be reduced, even partly, regulation by other means will be much easier. And this question needs careful investigation. The most pressing need at present is to isolate, with reference to the whole drainage area, the most serious parts contributing to the flood menace; and it is as a preliminary effort in this direction that the present study has been made. Although very rough, its value, if any, is perhaps that it points the way to further localization and investigations.

Plan Japanese Nickel Refinery

The Showa Mining Company, affiliated with the Japan Electric Industry Company, until recently known as the Japan Iodine Company, has been investigating since about 1932 the possibility of undertaking nickel refining with sulphuric acid nickel ore a raw material. This ore is produced at the Natsume Mine in Hyogo Prefecture. A series of experiments have resulted in the probable success of this prospective industry, which has no parallel, according to *Rengo*.

Nickel refining at present is done by means of two methods the Mond system and the electrolytic method—but both of these methods have their own technical defect. This method is not only a novel one in Japan, but the first venture of its kind in the world. It is regarded as the best process of refining nickel. Showa Mining has already set about constructing a refinery based upon the remarkable invention. Work will be started in about May next year at the latest.

Would Oust Imported Nickel

Should results from the process proves satisfactory, the enterprise is slated to be transferred to Japan Electric Industry organization and conducted on a big scale with the object of ousting the present annual import of nickel and its alloys amounting to about 5,000 tons from the United States valued at about Y.20,-000,000, thereby making Japan self-sufficient. It is reported that Japan Electric Industry is making necessary preparations to double its capital to Y.25,000,000 to launch the new enterprise and to expand the aluminum industry.

Methods of manufacturing alumina and potassium chloride from material of ferro chrome and alum of the Chichibu Electric Industry Company, which was recently absorbed by Japan Electric Industry, were recently secured by patents. A Patent is expected to be issued for the new method of nickel refining. Consequently, the first patents for manufacturing aluminum and nickel will be owned by Japan Electric Industry.

Another Firm to Branch Out

The Sumitomo Aluminum Manufacturing Company, the Kokumin reports, has decided to undertake the new method of manufacturing alumina, as well as super-phosphorites, from phosphorites, known as phosphatic alumina, which is produced at Daito Island in Kagoshima Prefecture and owned by the Japan Sugar Manufacturing Company. Negotiations to buy phosphorites from this concern are progressing and are expected to be concluded with it in the near future. Japan Sugar, it is said, intends to co-operate with Sumitomo Aluminum in the aluminum industry.

Why Sumitomo Aluminum has decided to turn its attention to the new method of aluminum manufacturing is, it is reported, that the concern originally planned to go into the aluminum industry in co-operation with the Asada Alum Company for the alum stones produced at the Gyokuriden Mine, Korea, owned by Asada Alum; but it found that Gyokuriden alum stones have a lower percentage of alum and potassium chloride, which is a by-product, than that available Japan Electric Industry. Furthermore, Japan Electric Industry may acquire a patent for manufacturing aluminum from alum stones.

Gas Plant at Fukien Christian University, Foochow*

By T. S. LIN, Member of the Association of Chinese and American Engineers, PAUL P. WIANT, Fukien Construction Bureau, Member of the Association ; and W. J. SUTTON, Fukien Christian University

FOR several years the Fukien Christian University had wanted to install gas for use in the various laboratories in the Science Hall. Gas is much the most convenient fuel for laboratory use and if properly made gives a hotter flame than the usual alcohol which is the next best thing to use when gas is not available. Moreover, alcohol besides being expensive and inconvenient and not so good to use, is a material which must be imported, mostly from Japan or Japanese controlled territory. For these reasons the University decided several years ago to install a gas plant when funds should be available.

Data on the installation of small gas plants is very hard to find; and of the personnel interested at Fukien Christian University and in the staff of the Fukien Construction Bureau no one was conversant with this sort of work. Therefore in the spring of 1932, Paul P. Wiant of the Fukien Construction Bureau, and W. J. Sutton, Professor of Chemistry at Fukien Christian University, made a tour of inspection and investigation. Gas plants were visited at the University of Shanghai, Soochow University, Nanking University, Ginling College, and Southeastern University. The gas plant at the University of Shanghai is the pioneer installation in China. It has been operated satisfactorily for many years and has served as the model and pattern of other similar installations. It was studied in some detail. However, we were able to use more data from the plant at Nanking University than from any other. We wish to acknowledge our grateful thanks to the authorities in all of the places visited because each plant had some special feature that helped us in the solution of our problem. Later on the plant at Yenching University in Peiping was visited and studied.

The location selected for the gas plant at the Fukien Christian University is a small ravine-like valley on the hillside between the E. C. Jones Memorial Science Hall and the Min River. This location was selected because it made a feed pipe line of minimum length and was most convenient for fuel supply. The general lay-out is shown on the accompanying drawings. The general scheme of operation of such a plant is as follows: a big fire is built in the furnace which heats the retort red hot; oil is dripped into the retort through a U-shaped pipe in the bonnet and is cracked into gas by the heat; this gas is formed at just above atmospheric pressure and passes out through the bonnet into a water bath, and thence into the 4-in. cast iron main through a tar barrel into the collection tank. This collection tank is balanced with counter weights to keep it just above atmospheric pressure.

In planning for improvements on the design of these small plants we confined our attempts to a redesign of the furnace, and provision for the easier elimination of tar and distilled oil. In both of these lines of effort we have been partly successful.

Furnace designs in all the plants we visited were based on the so-called Mansfield gas generator. In fact, in most cases the furnaces were exact copies made from the original one imported from England for the University of Shanghai. Our improved design was based on better insulation by means of brick inclosing walls, and we also attempted to get something of the Dutch oven effect by increasing the distance from the grate bars to the retort. The Dutch oven part of the experiment was not successful, and the furnace had to be rebuilt as outlined on the cross-section drawing. One other feature has been successful. Instead of using the large piece of specially designed fire brick over the fire, we set out a projecting ring of standard shapes of fire brick to deflect the flames. This feature has proved quite successful and very economical.

We also changed the shape of the retort from an oval cross-section to round, thus making it much easier to cast. The apparent reason for the oval-shaped retort was to allow the admission of two streams of oil: but in plants visited we noticed that without exception they were using one stream of oil only, hence our decision to try a round rather than an oval section. It has proved to be fully as good in every way, and besides was easier to cast and is easier to handle and clean.

We went to unusual pains in trying to eliminate trouble from tar and distilled oil. All the pipe lines pitch to low points from which it is easy to remove tar. Clean-outs were provided at every turn, and have already proved to be very desirable.

On account of the low location on the leeward side of a high hill it was anticipated that there would be trouble with down drafts in the stack. The original design called for an eighty-foot, all-concrete, self-supporting stack, but this had to be abandoned on account of its cost, and a forty-foot sheet iron stack was substituted. The base was designed and built for the concrete stack which may be added later. So far the one built has proved of ample capacity, and there has been no serious trouble with down drafts.

We have had more difficulty with the steel gas holder than with any other part of the plant. This was contracted for separately from a supposedly reliable firm in Shanghai. They guaranteed it against leakage but we have had constant trouble with leaks, which are not yet all eliminated.

The concrete water tanks in which the steel gas holders operate have been given a special design with a man-hole at the side, making easy access.

The piping system as laid out is entirely flexible. Gas may be generated in either one or both of two generators at the same time and may be led to either of the two gas holders. The gas pump is so connected that gas may be pumped from either tank to the other; and air may be pumped into either tank. The generating and pumping do not interfere in any way with the use of gas, and service is maintained at all times without interruption. Inlet and discharge piping have been kept separate.

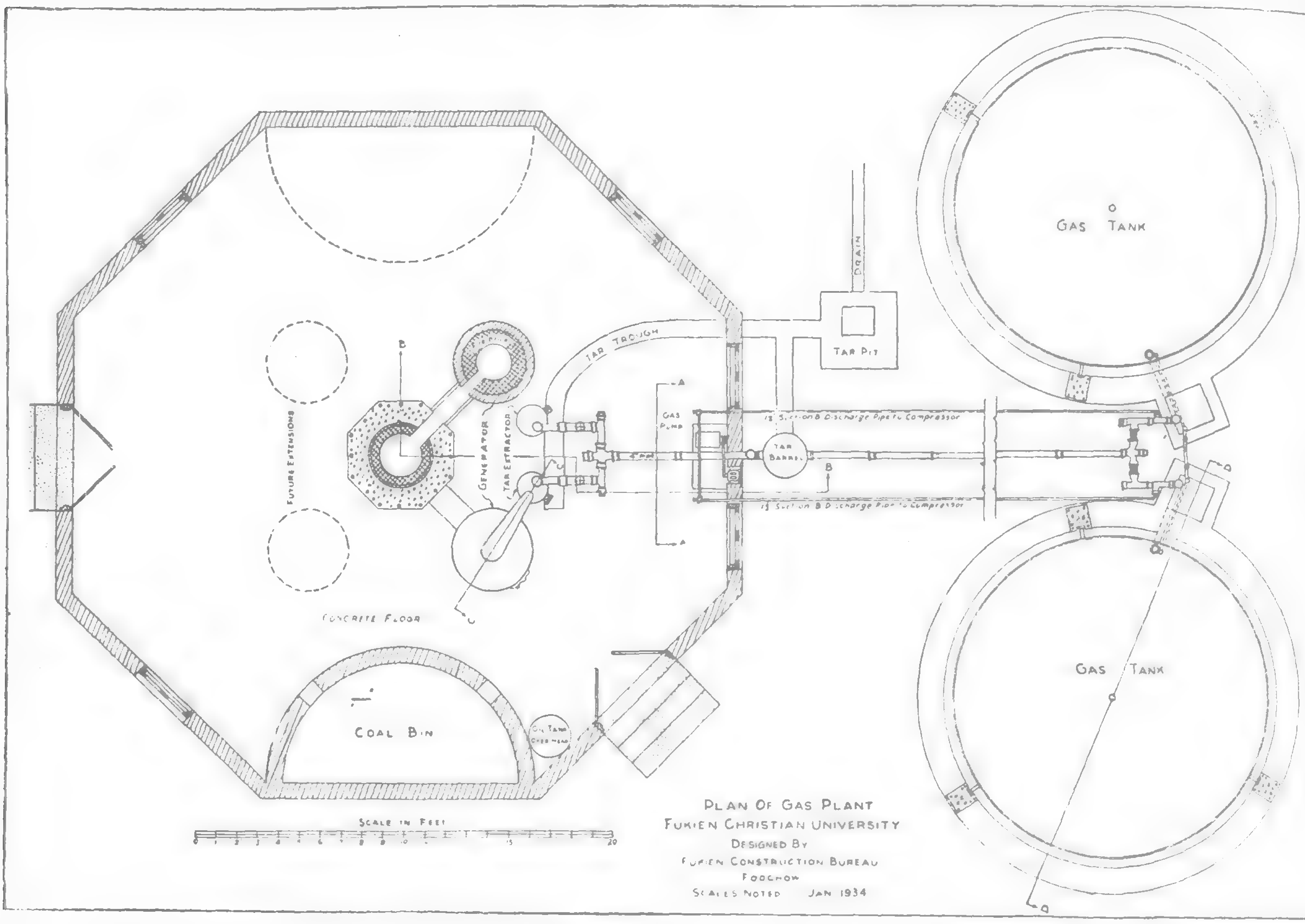
The Gas Plant at Fukien Christian University, Foochow

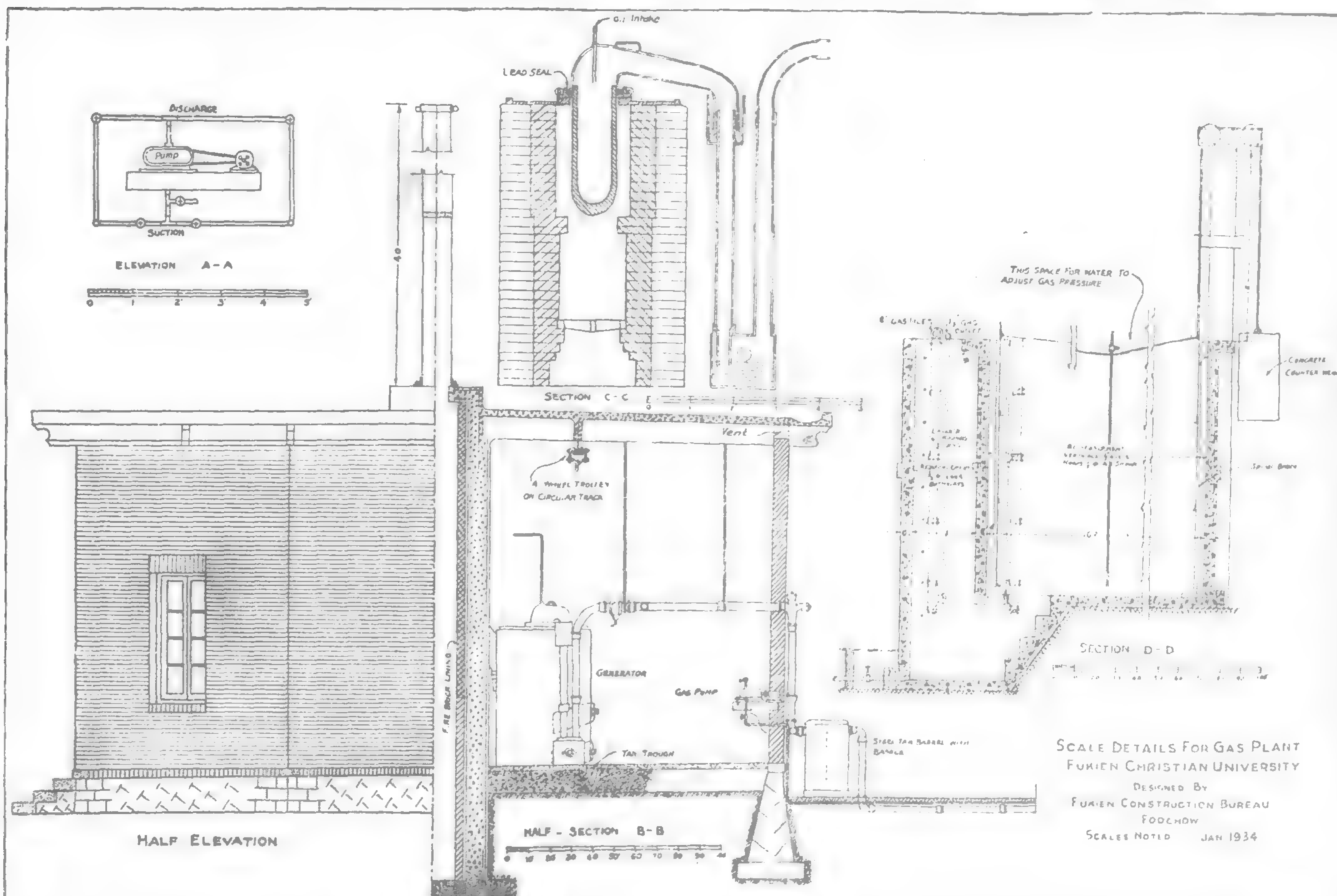
Operation

Before starting up the plant for a day's run, carbon which was deposited in the previous run must be removed. This carbon is mostly in the form of soot or a porous coke, hard in the bottom part of the retort where heat is most intense but light and fluffy in the top and in the bonnet. When ordinary light Diesel oil is used, only a little carbon is deposited, generally in the form of light coke which condenses

(Continued on page 522)

* Journal of the Association of Chinese and American Engineers.


Gas Tank
Gas Tank
Drain
Tar Pit
Tar Trough
Generator
Tar Extractor
Gas Pump
Tar Barrel
Future Extensions
Concrete Floor
Coal Bin
Scale in Feet
Plan Of Gas Plant
Fukien Christian University
Designed By
Fukien Construction Bureau
Foochow
Scales Noted Jan 1934


Discharge
Pump
Suction
Elevation A-A
Lead Seal
Section C-C
Vent
4 Wheel Trolley on Circular Track
Generator
Gas Pump
Tar Trough
Fire Brick Lining
This space for water to adjust gas pressure
Concrete Counter Weight
Section D-D
Half Elevation
Half - Section B-B
Scale Details For Gas Plant
Fukien Christian University
Designed By
Fukien Construction Bureau
Foochow
Scales Noted Jan 1934

Flood-Lighting in Malaya*

Considerable attention has been directed recently on the Port of Singapore, largely owing to its strategic situation in the Far East. The only reason, however, for this reference to it is the fact that a particularly interesting and efficient system of electric lighting has just been completed at what is known as the Telok Ayer basin, near the center of the inner harbor. The lighting system is similar in many ways to that installed at the West India Docks controlled by the Port of London Authority, a system that has won the unqualified approbation of Harbor Authorities in all parts of the world.

The need for a highly efficient system of lighting was found to be of paramount importance in the Port at Singapore, for the "Cross-roads of the East," as it is designated, is a hive of shipping industry to-day.

The harbor itself is practically land-locked by islands, and these afford such protection that until the reconstruction of the wharves a few years ago, the berthing accommodation consisted only of wooden ramps on wooden poles. To-day the port limits cover an area of 36¼ square miles, and comprise an inner harbor, outer harbor and western anchorage. In addition to large ocean-going passenger and cargo steamers, hundreds of coasting vessels call at the Port. The majority of the larger freighters berth at the modern wharves, but many others discharge and load in the inner and outer harbors, necessitating a continual flow of lighters to and from the warehouses on the banks of Singapore's short and narrow river and the Telok Ayer basin.

The Malacca General Hospital flood-lighted on the night of its official opening

The last named basin has a stage, totalling 3,077-ft. in length, available for landing cargo. The lighting of the landing steps and the 50-ft. wide roadway is carried out by means of 26 G.E.C. lanterns of the P.L.A. type mounted on 30-ft. poles spaced 130-ft. apart, and housing 500 watt Osram lamps. The extremely satisfactory results of this scheme, in so far as its application to the peculiar requirements of navigation and dockside activities are concerned, may lead to the further adoption of similar lanterns and lamps. Already the lighting—controlled by Venner time switches—has shown that it contributes to marked saving in the periods involved in the handling of vessels and the discharge of their cargoes, for many "tides" can be worked which would be impossible under a less efficient system of dockside illumination. As the illustrations show, the dock sides and roadway are clearly revealed, the wide lateral dispersion of the light being one of its most satisfactory features.

It is of interest to record that, apart from the Telok Ayer basin, the wharves, docks and roads throughout the Port of Singapore are lighted generally by Wembley lanterns. There are approximately two hundred of these in service, and they are equipped with Osram lamps of 500 to 1,000 watts.

The Harbor Board possesses its own power station, and included in the generating plant is a Fraser and Chalmers' turbine made at Erith.

The Board, through its chairman and general manager, Mr. G. W. A. Trimmer, M.I.C.E., M.I.M.E., M.I.T., has expressed its highest satisfaction with the new lighting installation at Telok Ayer basin, but every credit must be given to the chief electrical engineer, Mr. F. H. Robinson, A.M.I.E.E., A.M.I.M.E., for his share in the successful issue of one of the most noteworthy undertakings in illuminating engineering yet embarked upon in connection with harbors in the East.

Imposing Hospital at Malacca

Malacca, one of the principal towns in the Straits Settlements—the collective name given to the Crown Colony formed by the British Possessions on, or adjacent to, the mainland of the Malay Peninsula—now has what is proudly declared to be the most up-to-date hospital in the East. It is certainly an imposing pile, and very spacious.

* *Eastern Engineering and Commerce*

The Dock side of the Telok Ayer Basin at the Port of Singapore, Illuminated by "Wembley" Lanterns Housing Osram Lamps

The "Wembley" Lanterns installed at the Telok Ayer Basin provide ample Illumination over Landing Stage and Roadway

Spectacular Illumination of St. Mary's Church at Kuala Lumpur

It was built under the auspices of the Straits Settlements Government, and cost approximately a quarter of a million pounds.

Electrical equipment has an important part in this hospital, and it is significant to note that the whole of the lighting fixtures, lamps, etc., were supplied by the G.E.C., through its branch establishment in Singapore. The lighting scheme is regarded as a fine example of British electrical practice overseas, and Captain G. H. N. Reay, the chief electrical engineer of the Public Works Department S.S., who was responsible for devising the whole lay-out, has been the recipient of many congratulations upon it.

The actual contractors were Messrs. John Morey & Co.. and every credit is due to this firm for having completed the large contract without a hitch.

St. Mary's, Kuala Lumpur

Illustrated above is the chancel of St. Mary's Church at Kuala Lumpur, in the Federated Malay States. Gecoray flood-lights and Osram lamps are used for this very spectacular lighting effort, and it will be noted that the very fine scroll work of the chancel arch now stands out clearly against the beautifully carved altar setting.

The illumination has been much admired by everyone visiting St. Mary's.

Gas Plant at Fukien Christian University, Foochow

(Continued from page 519-520)

from the tar near the top of the retort. If heavy oils are used more coke is produced but less oil is lost by distillation.

With the present demand for gas the generator must be operated one day in every eight or ten. A coolie of more than average intelligence has been trained to operate the plant with but little supervision. The heavy retort and bonnet are lifted by a chain hoist running on a circular track which permits one man to handle these units without help.

Fires are started about 4 a.m., using wood and some tar-soaked waste from the tar catchers. Kailan Mining Administration slack coal is used, approximately 800 pounds being needed for two furnaces for a day's run of twelve or thirteen hours.

The furnaces are heated slowly, requiring four or five hours to get the retorts to a bright red heat, ready to generate gas.

The bonnets to conduct the gas from the retorts to the tar catcher should be in place while the furnaces are heating. The seal from the bonnet into the down pipe is made by approximately eight inches of water which is maintained during operation by a slow stream from a faucet, the overflow going into the tar catcher below.

The retort end of each bonnet is sealed by molten lead and tin. We found it necessary to add a certain amount of tin as the melting point of lead was a bit too high and some time was lost waiting for the lead to melt and make a seal. By the addition of tin the melting point can be lowered to any desired temperature down to the eutectic of 63 per cent tin melting at 180° centigrade.

When the retort is hot enough and the seal melted, the furnaces are ready to generate gas and so the oil is started dripping. The valves leading to the gas holder are opened immediately. After about five minutes the gas cock on top of the tar separator is opened to observe the color of the gas which emerges. If the color is white or grayish, either the oil is dripping too fast or the retort is not hot enough ; if dark brown or black, the retort is too hot and the oil should be run in faster or else the fire checked. The proper color is a light brown. The gas holders are arranged with water tanks on the top to regulate the pressure. When used as a receiving holder the water from the tank on top is all run out, leaving the holder almost exactly balanced at just above atmospheric pressure. During the period of about eight hours that gas is being generated the operator must keep the fire steady and test the gas at frequent intervals to see that it is a proper color.

So far we have tried out only two grades of Diesel oil, the light and the heavy, each giving about equal success in gas making. The difference in the two is that the light oil gives more trouble with distilling rather than cracking and the heavy oil gives more tar and coke.

The gas as generated is pumped through a Roots Rotary Positive Gas Pump furnished through Andersen, Meyer and Company of Shanghai, from the gas holder at just above atmospheric pressure to the storage tank which is kept at a pressure of about six inches of water. As generated the gas has a high percentage of unsaturated hydrocarbons such as ethylene and is too rich for use alone. It is diluted by adding air in the proportion of 55 per cent air to 45 per cent gas. In this dilution there is no danger of explosion as the air content is far too low to be dangerous.

So far we do not have satisfactory figures on the cost of operation. No formal exact tests have been made. However, it is expected that tests will be run and data accumulated in the next year or two. When available information on operation will be given to the public.

Acknowledgment is made to the China Medical Board of the Rockefeller Foundation for the contribution of Mex. $5,000.00 toward the cost of this plant. It was anticipated that this contribution would be half the cost, but the final figures showed a cost of over $16,000.00 for the complete installation, including the distribution piping and gas cocks.

Japan's Population Problem

(Continued from page 487)

the next twenty years, the greater part of the future increase in the working population will be absorbed. Such an expansion is by no means impossible when we consider the strides our trade has made in the past.

Against this we must set the entirely new world situation—an alarming contraction of international trade as the result of currency instability and policies of increasing economic nationalism. Despite the fact that more recently Japan has been able to gain an unexpected increase of exports, largely because of the falling value of the yen, this advantage will disappear when the exchange rate is stabilized. And counter-measures, high tariffs and quota restrictions, have tended to make our trade situation precarious.

If other countries are ready to buy Japanese manufactures and the Japanese people can raise their standard of living, the country is certain to become a highly profitable market for raw materials, such as wheat and wool, in which a rapidly expanding trade has already developed. It would be regrettable if this fact were not realized and efforts were not made by other nations to examine the possibilities of reaping benefit from Japan's foreign-trade expansion rather than to hinder it—with possibly calamitous results.

The New Kiangnan Dry Dock

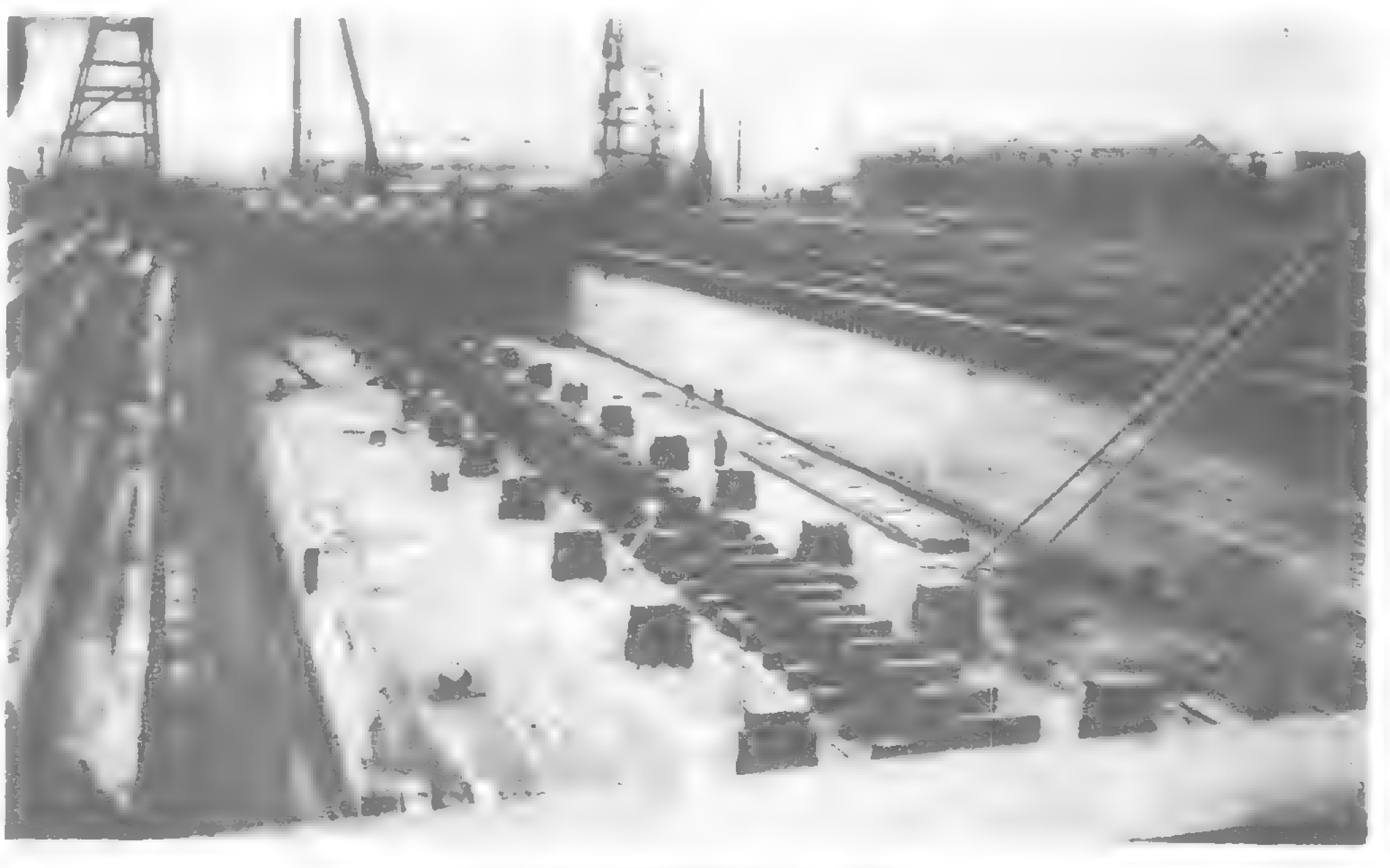
The opening ceremony of the newly constructed dry dock (to be known as Dock No. 3) of the Kiangnan Dock & Engineering, Works, Kiaochangmiao, Nantao, took place on October 10, the Chinese National Holiday, when the Chinese cruiser *Yat Sen* was docked.

The Minister of Navy, Admiral S. K. Chen, decided about a year ago to have this dock constructed with a view of accommodating deeper draft and longer vessels than have formerly docked in Shanghai. The projected length of this new dock is 640 feet, and at present the inside length is 386 feet.

The contract for the intended extension is under consideration and work will be commenced immediately upon removing buildings on the proposed site.

Situated on the west side of the No. 1 Dock (which has a length of 550 feet), which is adjacent to the shipyard, the new dock has a breadth at the entrance of eighty feet and a depth of 27-ft. and 8-in.

The side walls consist of a double row on each side of " Larsen " steel sheet piling containing an alloy of copper which is guaranteed to give a life of 80 years. The frame work of the terracing is constructed of reinforced concrete struts spaced five feet center, formed to take the wood planking to receive the shores which support and hold the vessels in equilibrium on the keel blocks. The entrance to the dock is constructed with an extra heavy type of " Larsen " piling securely stiffened by channel irons and connected by 3-in. dia. ties carried back to a longitudinal system of anchor piles about 65 feet long. This piling connects with two strong boxes of heavy construction which form the entrance and which the caisson butts against effectively making a watertight joint.



The New Kiangnan Dry Dock

The flooring of the dock inside the entrance is of 6-in. and 4-in. pine, laid on 14-in. by 14-in. pine beams spaced 5-ft. centers. The beams are supported by round piles 14-in. center diameter and having a length of 38-ft. These circular piles are connected to the beams with heavy straps fitted over the beams and connected by bolts.

The entrance and sill are supported on reinforced concrete piles spaced about 4-ft. centers, and have a solid foundation o. concrete on top 4-ft. thick to which is attached the 6-in. flooringf

The Dock Bottom

The dock bottom has a camber of 8-in. to allow water to drain rapidly to sump and the dock bottom is constructed with a 6-in. rise no gutterways being employed, as it was considered a means of collecting mud and preventing a clean dry bottom.

The sump has been arranged and is 10-ft. wide and 4-ft. deep, constructed of steel sheet piling with the usual perforated steel plates to permit of ample flow of water to the pumps. Ladders on each side for access to bottom of dock are hinged and tucked in behind the inner side of the entrance boxes. Slopes for the removal of heavy gear from vessels to the shops are placed at head of dock in close proximity to the railway. The steel caisson which closes the entrance of the dock is 86-ft. long, 18-ft. wide, 28-ft. 6-in. deep and has a displacement of 1,200 tons. It is built on the longitudinal principle and has two steel decks, a center bulkhead and one transverse bulkhead to tank deck. Above tank deck are two steel bulkheads that fill compartment with the rise of an exceptionally high tide and automatically prevent the caisson from jumping.

Electrically Driven

The caisson is fitted with an electrically driven centrifugal pump having an 11-in. suction and discharge.

The suction is divided into two 8-in. pipes to enable the caisson to be kept level when being raised. This pump is directly connected to and driven by an electric motor of 75 h.p.

Two large sluice valves 48-in. diameter with steel pipes are fitted through the caisson, to unable the dock to be flooded quickly. These valves are operated from the tank deck, the operating wheels being fitted on bulb bearings.

The caisson is designed to be able to float in a stable condition on a light draft to enable the dock to be used at any state of the tide.

The pumps installed are two-Vickers—Gill 29-in. Axial Flow Horizontal Spindle Propeller pumps each delivering 31,700 Imperial gallons per minute (8,470 long tons per hour) against a total head of 27½-ft. when running at 720 r.p.m., absorbing 352 h.p., having an efficiency of 75 per cent. Each pump is direct coupled to one " English Electric " A.G. S-15 Protected Type Slipring Induction Motor capable of developing 380 h.p. at 720 r.p.m. wound for three-phase, 50-cycle, 400-volt supply, fitted with brush lifting and short circuiting device.

The Drain Pump

The dock drain pump is of the Pulsometer Engineering Co.'s Type " E10 " Centrifugal Pump with 12-in. suction and 10-in. delivery branches to deliver 2,800 Imperial gallons per minute against a total head of 27½ feet, absorbing 32 h.p. mounted on a cast iron combination baseplate, direct coupled to an " English Electric LKS-17 " motor capable of developing 40 h.p. at 720 r.p.m.

The pumps were supplied by the Jardine Engineering Corporation, Ltd. The suction pipes of the large pumps are 40-in. dia. and discharge into a tank which has a main discharge pipe of copper steel 6-ft. in diameter which is laid well below the low water level and led to the river.

The lay out of the pump room is well arranged and is contained in a steel tank placed at the lowest depth possible.

The pump house is a handsome red brick building, containing separate hot and cold water baths for officers and men elaborately fitted up with modern plumbing, with kitchens and store room, etc., and operating engineers' quarters. The boiler house is situated at the head of the dock and contains a large Scotch boiler, coal bunker and boiler attendants' quarters. This boiler supplies steam to four ten ton winches which operate the vessels in and out of the dock. Powerful double geared hand capstans are also fitted as auxiliaries for this work. The electric light cable are carried on reinforced concrete poles and lamps are placed at suitable intervals around both sides of the dock.

Engineering Practice in the Shops of Medan, Capital of Sumatra

By WALTER BUCHLER in "Eastern Engineering and Commerce"

Pipework in the Deli Estates Shop, Medan, Sumatra

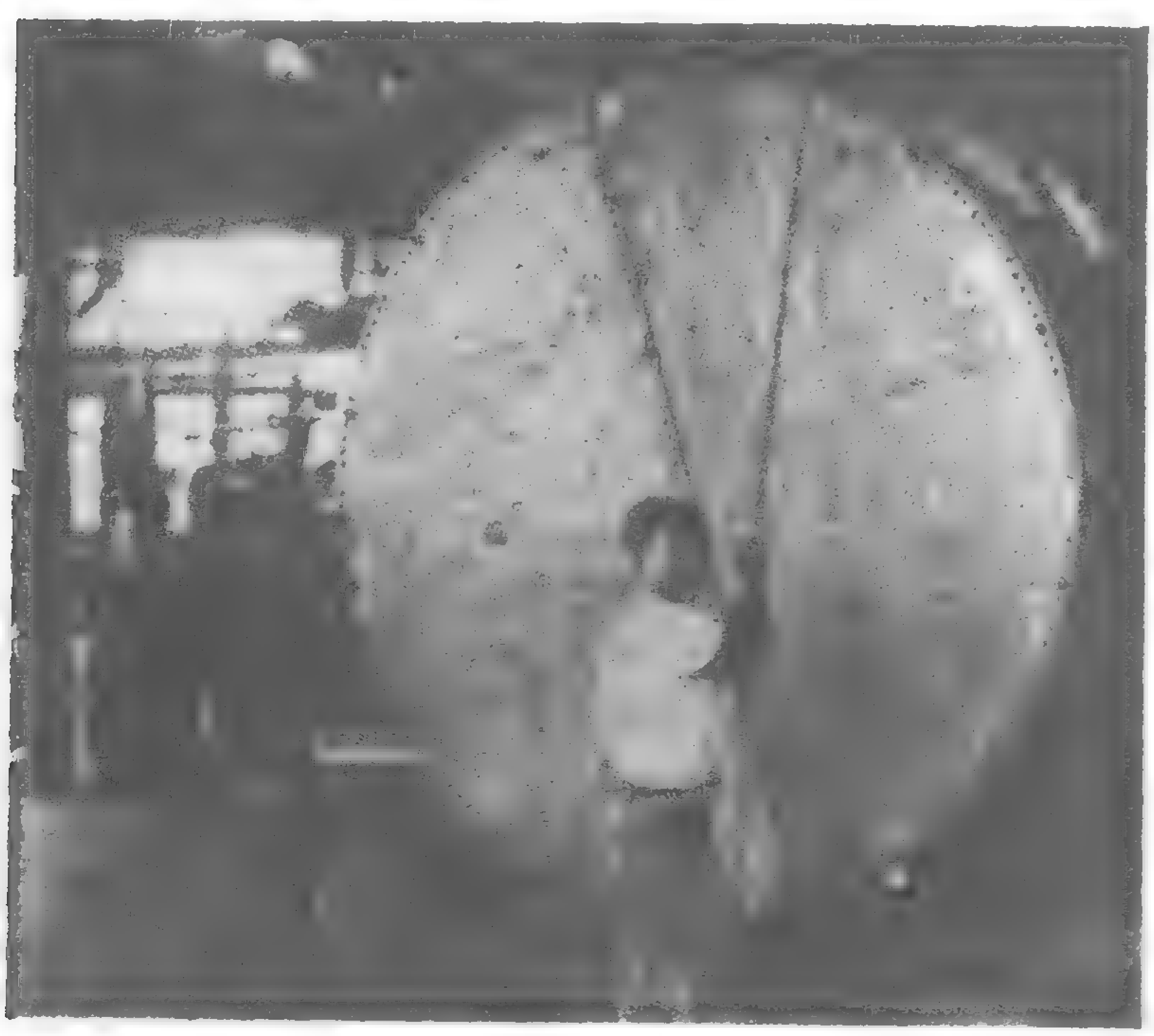
THERE are two well-equipped European engineering shops in Medan, capital of Sumatra, and numerous small shops run by Chinese or Javanese. The former do all manner of engineering work, steel construction for buildings, bridges and estate work. Sumatra is primarily an agricultural country with tea, tobacco, rubber as its more important products exported. The Chinese shops do any small job brought to them, be it a motor-car requiring repair or overhaul, or a bicycle, of which there are literally thousands in use in the country. The labor is principally Javanese, and to a lesser extent also Chinese. The Sumatrans do not take kindly to shop practice, and where employed in these shops are apt to take the line of least resistance in any work they do.

The men come in as boys, or they may have already had experience in Java, or in the case of Chinese in China, usually Hongkong or Canton. There is no system of apprenticeship, and according to the ability they show the boys are kept on and given an opportunity to rise. They may become turners, machinists, or fitters, but at present there is rather a glut of all these tradesmen on the market; in better times, estates maintained their own repair shops, employing a number of fitters and engine drivers, and paid them a higher wage than the larger shops in the towns could afford to in competition with others, nor could they offer the same housing facilities and other amenities available on these estates. With the slump in rubber, tea and tobacco, but more especially rubber, estates closed down and flooded the market with fitters, engine drivers and other mechanics, with the result that now there is a surplus of all trades.

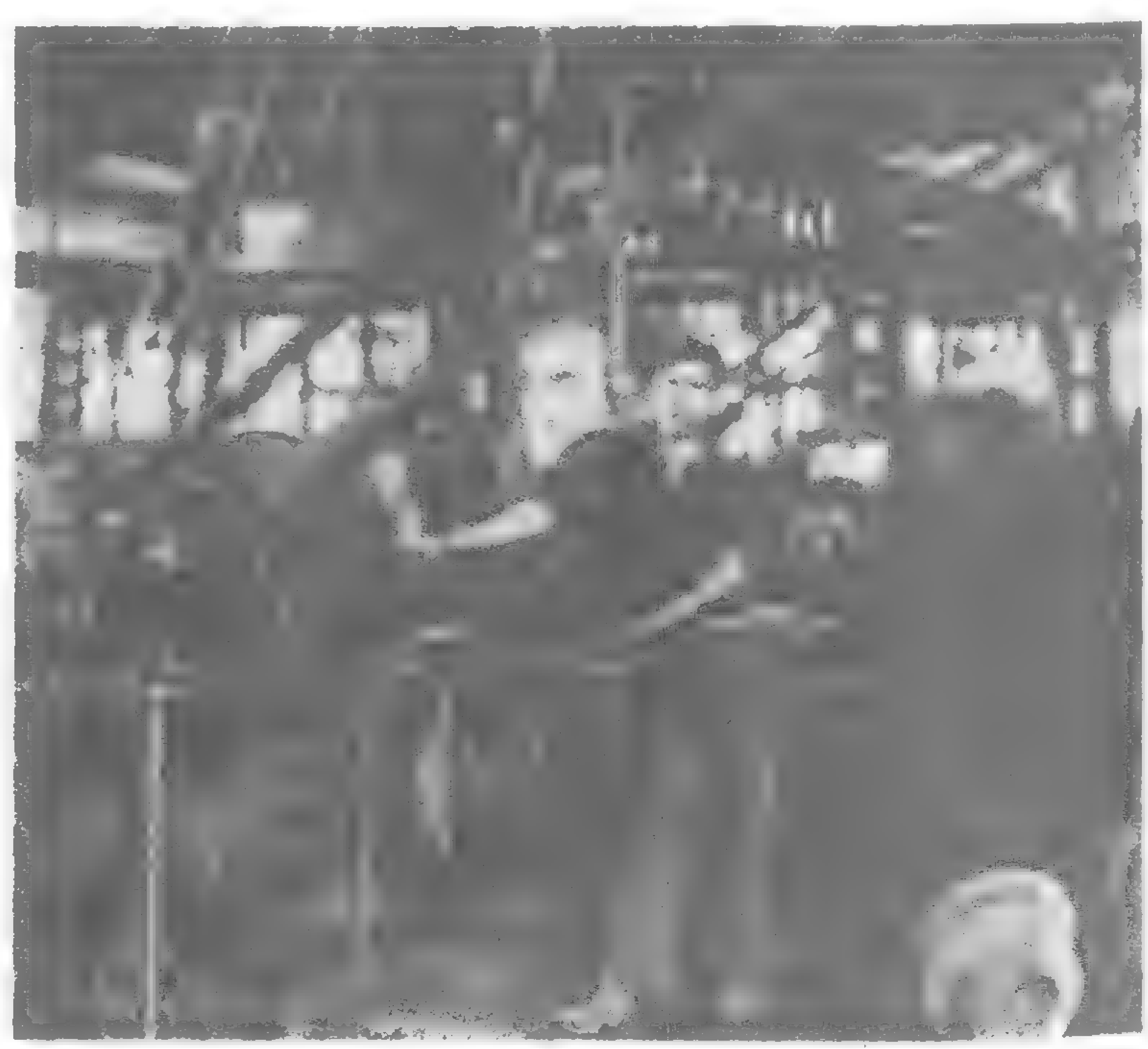
Stamping holes in the Deli Estates Shop

The Dutch Government has opened schools for natives giving them an elementary education and shop practice, but it seems that they are trained to something better than they can get, with the result that many drift into other occupations which do not entail "dirtying their hands" or putting on overalls. That is the tendency to-day in Sumatra with the younger generation who aspire to some education. It is quite surprising how quickly a coolie in Sumatra will turn himself into a Tukan (craftsman) after picking up a smattering of a fitter's, turner's, or other tradesman's job. This necessitates a tremendous lot of supervision on the part of the European foreman over the men. Many are unable to read drawings,

(Continued on page 527)



Boiler work in the Deli Estates Shop



A Lathe at Work in the Deli Estates Shop

Narrow Gauge Diesel Locomotives for Assam*

Budla-Beta's New Engine

W. G. Bagnall Ltd. of Stafford, who have taken over the manufacture of the Deutz Diesel locomotives in Great Britain, have recently tested two standard types, a 50 h.p. 0-4-0 type for the meter gauge lines of the Assam Railways and Trading Co., Ltd., and a 22 h.p. 0-4-0 type 2-ft. 6-in. gauge engine for Budla-Beta Tea Gardens, Assam.

Both locomotives have been built to the inspection of Messrs. Robt. Bruce & Son, consulting engineers, London.

Details of 50/55 B.H.P. Locomotive

The 50/55 b.h.p. at 500 revs. loco. is driven by the latest type of airless injection, two cylinder, two stroke Bagnall-Deutz Diesel engine, with directly connected scavenging air pumps, simple in design and thoroughly reliable.

The scavenging of the engine is effected by fresh air supplied by the scavenging air pumps. All moving parts of the engine are connected to the circulating forced lubrication system, with gear wheel oil pump, which supplies all places with oil so abundantly that not only is the lubrication excellent but the bearings are also cooled.

The fuel pumps of the cylinders are regulated by a precision centrifugal governor, so that they supply with each revolution of the crankshaft just as much fuel to each cylinder as is required by the momentary load. The fuel tank has a capacity of 15 gallons, sufficient for 12 hours' service.

A centrifugal pump, driven by the engine, circulates the cooling water through the cooling jackets of the engine and through a radiator with ventilator, which is securely fixed in such a manner as to protect it against damage. The consumption of cooling water is extremely small and only the evaporated water requires replenishing.

The engine can be started by means of compressed air, which is produced by passing part of the exhaust gases through a non-return valve into the compressed air tank. During brief working pauses which are too short for the engine to be shut off, the normal speed of the engine (500 r.p.m.) can be reduced to about half by means of a special regulation device.

The power is transmitted from the engine to the coupled driving wheels by a transmission shaft and a four speed gear, running in oil. To protect the gearbox from the effects of possible distortion of the frame, it is suspended at three points on the engine frame.

A double disc central friction coupling is employed as a clutch which is actuated by oil pressure applied by a hand-operated slide valve. The oil pressure and therefore also the pressure of the clutch can be varied within a wide range. Through the effective cooling, the coupling allows of an exceptionally long friction period. This, and the wide range of speed regulation of the engine result in an absolutely soft and smooth starting and gear changing.

All parts of the gear mechanism run on roller bearings. The gear wheels are case hardened steel. The speed gears are actuated by a link system and the direction of running is reversed by a simple hand lever. The axles are driven from the transmission shaft by driving and coupling rods. All control levers, etc., of the locomotive are systematically arranged in the driver's cab in convenient positions.

The speeds, drawbar pulls and loads hauled are as follows :—

Weight of loco. in working order..	11½ tons.
Fuel consumption per hour ..	12 lb. in service.
Speeds	3, 5, 7 3/4 12½ m.p.h.
Drawbar pull	4,840, 2,904, 1,628, 858 lb.

Loads hauled basing frictional resistance at 15/lb. ton—

On level	300	190	100	50 tons.
1 in 200	170	100	60	30 tons.
1 in 100	130	80	43	24 tons.
1 in 20	38	24	—	— tons.

Budla-Beta's Locomotive Specifications

The 22/24 b.h.p. smaller loco., also illustrated, is driven by a 2-cylinder two-stroke engine exactly identical in principle to the larger loco. but having a higher speed, *viz.*, 700 r.p.m., the cyls. being 5-in. diameter by 6¾-in. stroke compared with 7-in. diameter by 10-in. stroke.

The smaller loco. also has a four speed gearbox, the clutch being of the conventional plate type operated by foot pedal.

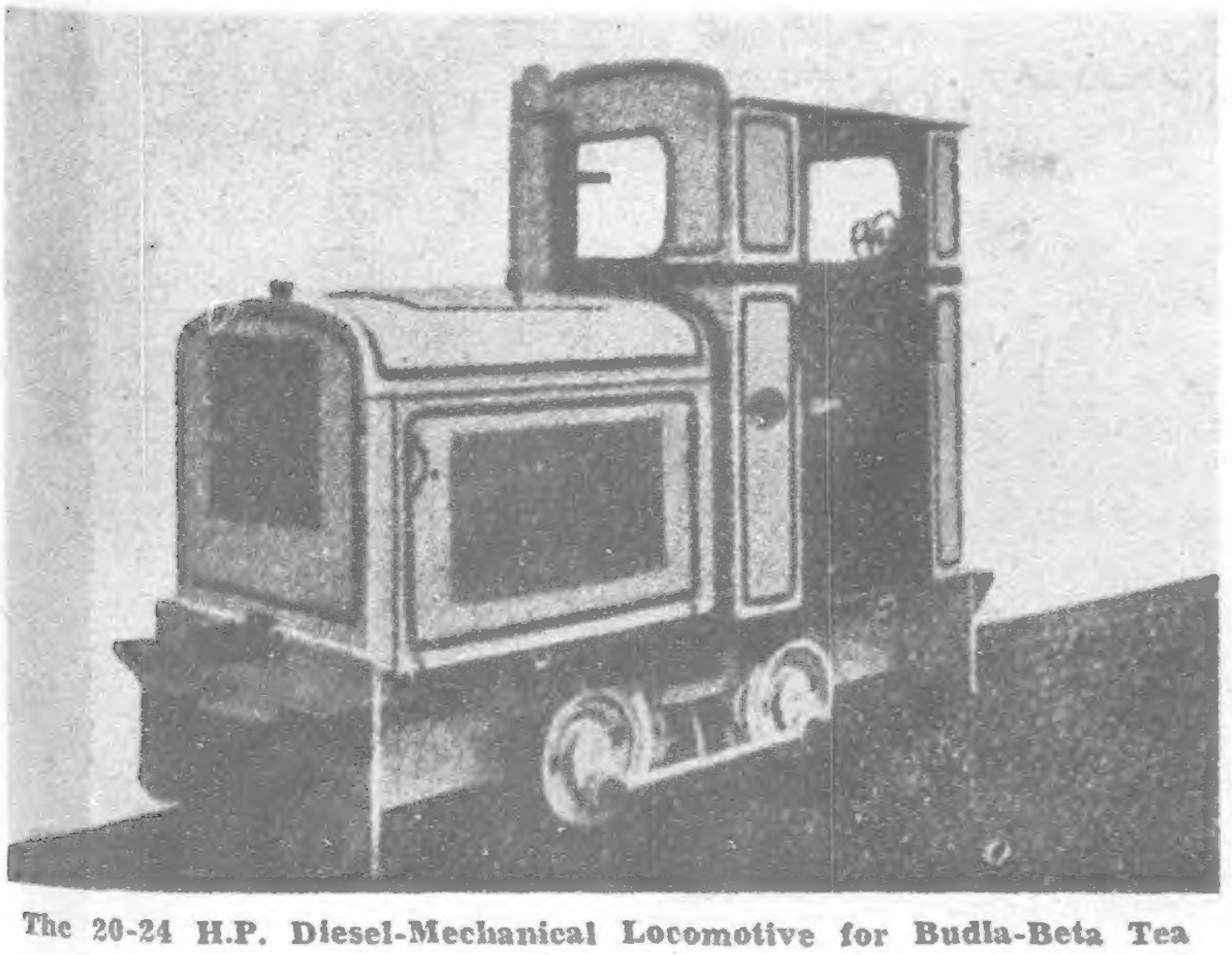
The engine and gearbox of this loco. are also amply proportioned and specially suited for locomotive work, the chassis is substantially constructed, the complete loco. presenting a very attractive appearance.

The principal dimensions are as follows :—

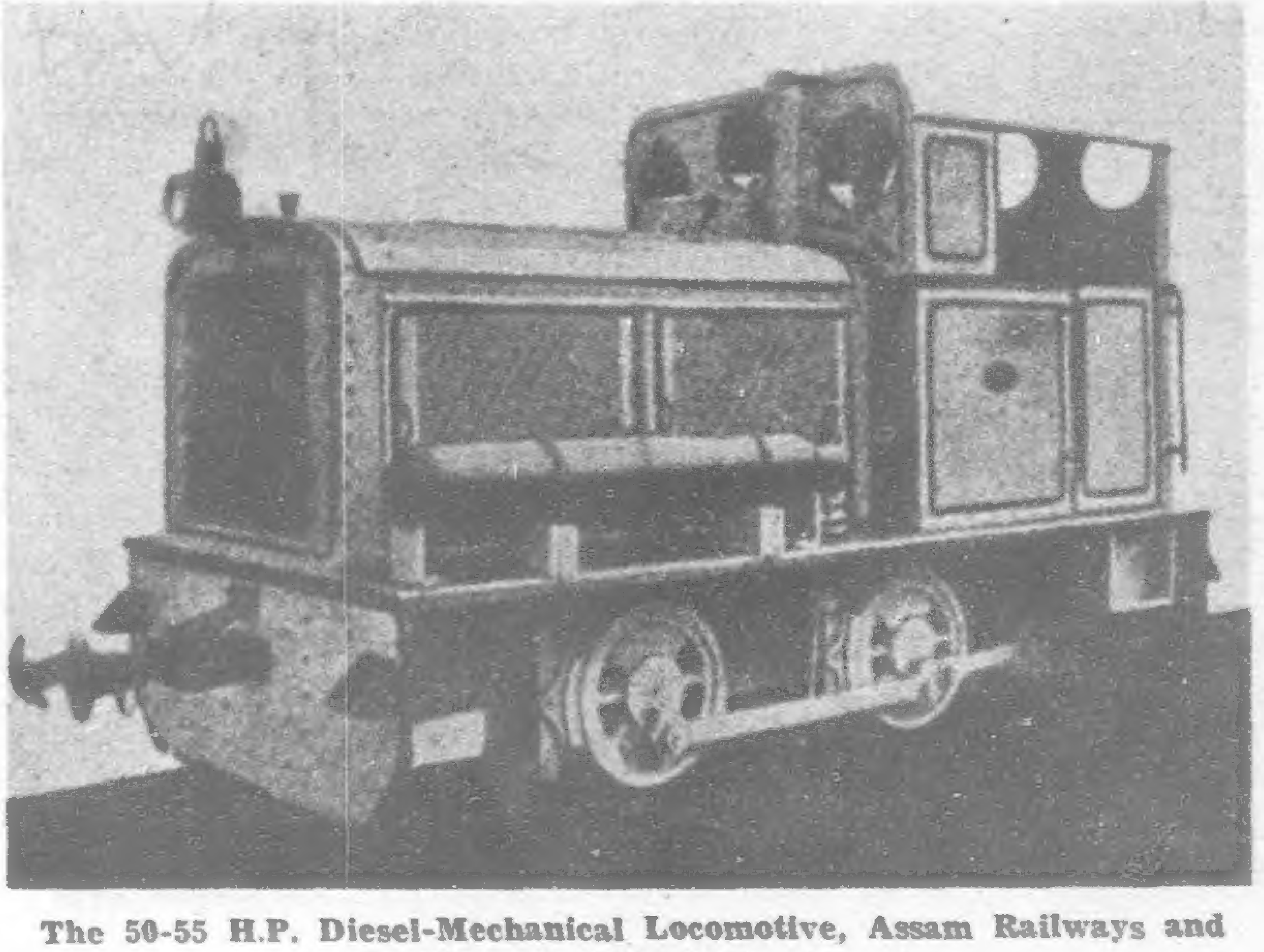
Weight in working order	4½ tons.
Length over buffers..	10-ft. 2-in.
Width	3-ft. 10-in.
Height	7-ft. 8½-in.
Wheelbase	3-ft. 0⅝-in.
Diameter of wheels	1-ft. 4-in.

(Continued on page 527)

* *The Planters Journal and Agriculturist*



The 20-24 H.P. Diesel-Mechanical Locomotive for Budla-Beta Tea Gardens

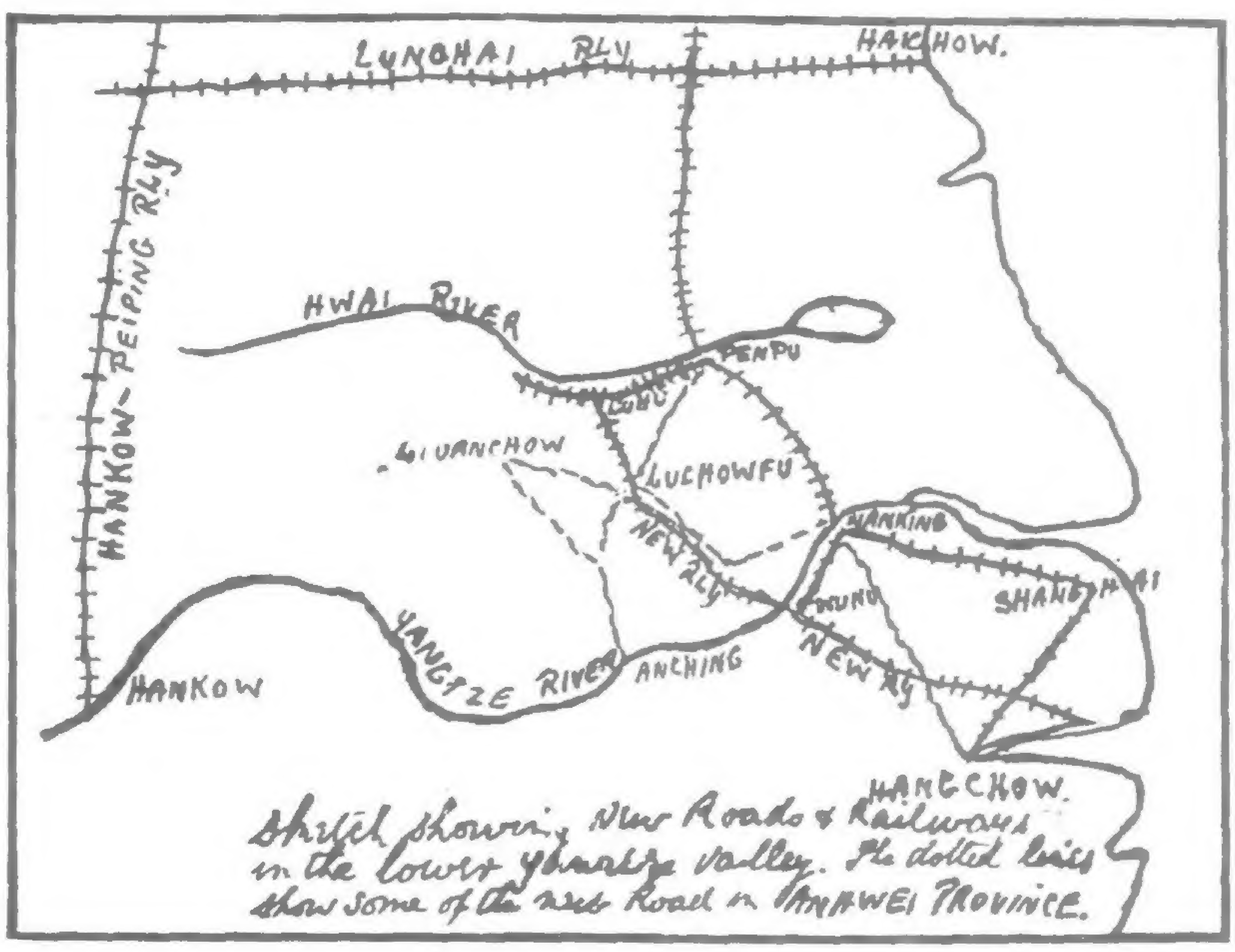


The 50-55 H.P. Diesel-Mechanical Locomotive, Assam Railways and Trading Co., Ltd., Meter Guage

New Era in the Yangtze Valley*

The province of Anhwei, up until recently one of the most backward provinces of all China, lies at the very center of the territory controlled by the present government of China. It's proper development is now seen to be vital to national economy. In natural resources it is one of the most favored provinces of all China. The rich Yangtze valley sweeps right across the centre of the province. This wide and fertile valley has a never-ending supply of irrigation waters from the Yangtze itself; moreover the rainfall all over the province is abundant and dependable. Its harvests of wheat, rice and other farm products are abundant and regular. Moreover the province is rich in coal deposits adjacent to great centers of population, and also has ample supplies of iron ore still undeveloped.

In spite of all these natural resources Anhwei is still in many ways totally undeveloped. It has no railways except where the Tsing-pu railway cuts through the north-east corner of the province. Until lately it has had no roads wider than a wheelbarrow or a donkey path. Anhwei's educational facilities are notably backward despite the natural ability of its people. The province has for many years been overrun with bandits, so much so that large military campaigns have been required many times within the past ten years in the effort to eliminate this scourge.



The New Railway Building Era

At last a new era is dawning for the lower Yangtze valley. Some important new railways are being built. Across the fertile plains and valleys to cities whose names not one in a thousand even of the Chinese people themselves have ever heard, these lines will bring the amazing changes of modern industry. Within months a railway station has been built at the city of Wuhu, the rails are laid, and a daily train is running for some twenty miles to a point where further construction is going on. This new line is reaching out toward Hangchow; the eastern terminus is to be the new port of Cha P'u on the northern side of Hangchow Bay. China can no longer afford to depend entirely upon the foreign controlled city of Shanghai as the only port for her rich Yangtze valley. The effect to open such ports as Cha P'u, and Haichow on the coast north of Shanghai is partly an answer to the Japanese attack on Shanghai two years ago. Perhaps at present it is a question whether they will do much more than make it more difficult for a foreign nation to hold a dagger at the throat of China as Japan did with a few airplanes and gunboats in her attack on Shanghai. A very large part of the new line will run through the rich-growing territory which for years made Wuhu one of the world's greatest rich-shipping ports.

Across the Yangtze River to the north-west from Wuhu another railway will extend on past the cities of Chaohsien and Luchowfu to the coal fields at Luho on the Hwai river, and thence connect up with the Tsing-pu railway near Penpu. A branch will run from Luho to Showchow and Chengyankwan. Work has already started on the northern section of this line. Miles of road-bed are already prepared for the rails. One of the principal purposes of this section of the line is the opening up of the coalfields in this part of Anhwei. Coal can thus be made available at a low price to ships on the Yangtze as well as to the railways in the southern part of the province. In a country where fuel is scarce, a supply of cheap coal is of the very utmost importance. What China can do in the shape of manufactures is just beginning to appear. Only five years ago the only manufactured articles seen for sale in the shops of inland cities were either Japanese or else Western manufactures. Now the Japanese goods are so rare as to be a real curiosity when seen, while the Western goods are largely sold at a price out of reach of the ordinary citizen. Instead, the shelves are filled with cheap goods of Chinese manufacture. It is the need for coal from local sources free from the dominance of Japan which has prompted the rapid development of China's unlimited coal resources.

Unlimited possibilities for the use of coal for household purposes exists in this part of China. The winters are very bitter and the people have no means of heating their houses. On account of this, most people having no artificial heat in winter have to spend much of their energy trying to resist the cold. One of China's first needs is the boon of cheap coal for the poor. Some people are prone to decry the benefits of our modern civilization these days; they do but need to spend a few weeks of the bitter winter weather in some poor unheated Chinese home such as ninety-nine per cent of the people live in, in order to change their minds about the need for such products of the industrial age as stoves and coal.

Another new railway is also to be built immediately from Wuhu to Nanking according to latest official reports. This will make still another link between the new lines and the Shanghai-Nanking-Peking system. This will bring Nanking within direct and quick reach of some of the most important territory now under her sway. The military will be within a few hours of some of the centers of former bandit and communist control in northern Anhwei.

Roads to Supplement Railways

New roads are being rapidly built to supplement the new railways now building or projected. A fine hard-surface road already connected with Hangchow by automobile road, and a new road is being constructed from Nanking to Shanghai. North of the Yangtze, a road is also being opened to connect Pukow and hence Nanking, with the northern part of Anhwei. The road is already in operation as far as Hanshan, and is opened all the way to Luchowfu to the north of the large Chao Lake.

A system of roads connects Anching the capital of Anhwei with the north-western parts of the province. A road connecting Anching with Luchowfu and Liuanchow is already being hard-surfaced. Comfortable busses are running on a daily schedule during fine weather. Another road connects Luchowfu with Penpu on the Tsing-pu railway. All these roads are of the greatest importance for the development of effective government control. Only a few years ago the section of the province west of Liuanchow was further away from Anching, so far as effective military control is concerned than Peking is from Hongkong. An organized Communist Government dominated this region for years after the year 1927 while bandits overran the whole section. Now with automobile connections, the district is but a few hours from the capital, and General Liu, the Provincial Chairman and Bandit Suppression Commissioner, is spending much time reorganizing this former red stronghold. Previous to the present year many market towns and even district cities have been looted by bandits who then got far away into their mountain fastnesses before the slow-moving soldiers could arrive on the scene. Now with a fleet of trucks

* *Hongkong Weekly Press*

operating on the new roads, the soldiers can get from one side of the province to the other in less time than the bandits can go twenty miles. A few days ago the writer while travelling in this section was waiting for a bus when the bus office received a telephone call. In a few minutes the bus was off with soldiers to capture bandits in a neighboring market town. The next day another bus went out to bring in the captured bandits, who were quickly disposed of, for the officials feel that the country can easily spare the loss of these characters.

While these developments are essential to the well-being of the people of China they also have their military significance. Japan was not slow to see this as is evidenced by her recent outcry against other nations helping in the development of China. It is of course, absolutely impossible to develop mines, roads, and railways that will be of use for the nation's general welfare and not also be of military use. Obviously the only way that Japan could keep China from becoming strong enough to resist outside aggression would be to keep the people in a condition of economic servitude bordering on famine and slavery. This is manifestly impossible in the face of the modern world even if the people of Japan desired to do so.

Only those who have observed conditions in those districts where famine sometimes strikes can realize how near to economic slavery many of the people of China live. At the same time it appears that great prosperity is equally near, provided the people can have access to all the wealth which nature has placed at their disposal.

Vast deposits of coal and iron lie all about them while a little way off are rich rice and wheat lands. Having only man power for transportation it is impossible to take the coal to the farmer and impossible to take rice to the miner. The new railways will make the magic link that connects the two and bring coal to the shivering farmer, and food to the hungry millions who are to find work in mine and factory. When coal is available for fuel good land which is now used for raising grass for fuel, will be used for raising crops or for feeding sheep and cattle, to supply the much needed wheat and wool. To most of us the lot of the factory hand does not seem particularly desirable, but it is at least better than the lot of the famine victim on the great northern plains. Thus with the coming of railroads and auto roads we are seeing before our eyes a very real transformation. Whether an awakened and modernized China will be as terrible a menace as Japan seems to think, still remains a question. However in view of the inevitableness of China's future place as a great power, it would seem better to adopt the attitude now being taken by the League of Nations and help to usher in an era of international co-operation by aiding in China's development.

Engineering Practice in the Shops of Medan, Capital of Sumatra

(*Continued from page 524*)

but in time, given repetition work, they become quite smart. Should they be confronted, however, with something a little different, they are absolutely lost. So it is always advisable to keep a few Chinese with training acquired in Hongkong or Shanghai shops. They are very keen and more skilled in engineering, and their interest in their work is not limited (as is the case with other native hands here) according to what they require for a living, which is very little. Chinese and natives do not readily mix together and usually work apart. The natives like to work on the ground in a squatting posture, but their method of handling tools is more or less the same as in the West.

For riveting, Chinese are preferred as they are physically stronger ; they are apt to heat too little, as they think that as long as it is hot it is enough, and have a habit of keeping one piece at a time in the fire without thinking of saving time and labor by putting three or more at a time. Whilst small boilers are made in the shops in Medan, most of the boiler work is in the form of repairs to boilers already in use. These are for the most part imported, as it does not pay to make anything large or, for that matter, small where quality is an important factor.

Moulders are natives and the jobs suit them. They do their work well on the ground, and no fault can be found with this set of tradesmen. The sand for moulding is imported, but suitable clay is obtainable in certain localities in Sumatra. Patternmakers are Chinese, using ordinary wood for patterns required. There is very little repeat casting ordered, hence there is little done in the way of metal patterns. Electro welding is carried out in the same way as abroad, and the men become quite expert after a little training.

Narrow Gauge Diesel Locomotives for Assam

(*Continued from page 525*)

Engine power developed—	
Continuous	22 b.h.p.
Overload	24 m.p.h.
Number of cylinders	2
Revolutions per min.	700
Fuel consumption per hour in service	5.5 lb.

The speeds, drawbar pulls and loads hauled are as follows :—

Speeds	1.87	3.24	5.42	9.68 m.p.h.
Drawbar pulls	1,980		1,066	506 lb.

Loads hauled basing frictional resistance at 15/lb. ton—

Level	130	70	34 tons.
1 in 200	75	40	19 tons.
1 in 100	50	28	13 tons.
1 in 20	15	—	— tons.

The radiators for both sizes of locomotives have been supplied by The Spiral Tube & Components Co., Derby and London.

Singapore New Prison

The office of Public Works, Singapore, received the following tenders for the erection and completion of the New Convict Prison : United Engineers, Ltd., $1,229,500, or (using Chromador steel) $1,218,000 ; Woh Hup, $1,300,000, or (using Chromador steel) $1,278,665 ; Fogden Brisbane and Co., $1,383,686, or (using Chromador steel) $1,369,251 ; Brossard Mopin (Malaya), Ltd., $1,390,000, or (using Chromador steel) $1,376,000 ; Woo Mon Chew, $1,420,000, or (using Chromador steel) $1,408,000 ; Gammon (Malaya), Ltd., $1,463,600, or (using Chromador steel) $1,451,700 ; Ng Poey, $1,493,500 ; Poh Ghee, $1,780,000. The alternative tender No. 2 of Messrs. Woh Hup ($1,278,665) was accepted. The tender is based on the market price of material and labor at date, and the right is reserved to increase the price tendered in proportion to any advance in cost of materials or labor during the progress of the work in excess of 3 per cent of the estimated cost, but should the cost of materials or wages fall below 3 per cent of the estimated cost the price for the work will be correspondingly reduced.—*Eastern Engineering and Commerce.*

Japanese Ferry Boat

The Japanese Railway Office will shortly build a 6,000 ton trans-Chosen Strait ferry, capable of covering the route in from six and half to seven hours, which will reduce the present running time by from one hour to one hour and half. Attaining a speed of 23 knots the new ferry will be the fastest passenger carrier flying the Japanese flag. She will accommodate 1,500 passengers. The construction cost is estimated at Y.4,000,000.

The number of channel crossing tourists has increased remarkably since Manchukuo was established. In every voyage, from 100 to 500 prospective passengers have had to be turned back due to the limited accommodations of the ferry fleet now in service.

Every thought and care will be exercised in the new boat's construction for the safety and comfort of passengers. Among the features to be incorporated are a device for circulating warm and cold air, depending on climatic conditions, electrically operated fire-localizing doors, and watertight compartments.

One of the distinct departures of the new vessel is the fact that far greater consideration is to be given to third class passengers than is usually the case ; a social hall and a spacious bathroom will be provided exclusively for them.

Engineering Notes

INDUSTRIAL

SINGAPORE'S CIVIC CENTER.—The plans for the reconstruction of Empress Place, Singapore, are under consideration by the Government a committee appointed some time back having submitted a report. Under a plan evolved in 1930 it was proposed to spend $8,500,000 on a new civic center where the Government offices, Supreme Court and theatre now stand. At the last Budget meeting it was stated that no scheme had yet been agreed upon. This year's estimates included $150,000 for a new Raffles Institution which is estimated to cost $750,000 when completed.

SHANSI DEVELOPMENTS.—General Yen's scheme for the establishment in Shansi of blast furnaces, a rail-rolling mill, etc., has not advanced much. The site now favored is adjacent to the existing steel plant and immediately north of the arsenal and not as originally proposed about 30 miles away in the western hills. Apparently there is no truth in the report that orders have been placed for plant and the matter has reached the stage where designs for furnaces are to be considered. During recent months Japanese have made frequent trips to Shansi and it is rumored that they wish to negotiate for the taking over of the mines and works at Yangchuan.

BRITISH MACHINERY FOR NANKING.—Tenders are to be invited by the Ministry of Industries for the construction of a central machine works at Chaohsiachia, outside Nanking city. A report from Nanking, states that Mr. Huang Han-ju, the secretary of the Ministry, will leave for England in connection with the purchase of machinery from British manufacturers, for which the Ministry some time ago secured a loan of £123,200 from the British Boxer Fund Committe. Construction of the works was delayed owing to the hostilities at Shanghai which caused a group of Shanghai bankers to cancel an arrangement to finance the erection of the works.

MITSUBISHI TO MAKE ALUMINIUM.—The Mitsubishi Mining Company has decided to go into the manufacture of aluminium, zinc and oil, using the hydrogenation process for the latter. Experiments have been completed and work is to start in the spring. A factory will be built near the Miuta coal mine, which the company operates in Hokkaido, together with a steam power generating station capable of 30,000 or 40,000 kw. It is reported that Mitsubishi Mining has succeeded in turning out one ton of crude oil and five tons of carbide from 10 tons of coal. It will go into the carbide industry as well. The plan for raising the necessary Y.10,000,000 for the aluminium plant includes Y.5,000,000 for the power station.

STEEL PLANT DELAYED.—Differences of opinion have arisen between the Chinese and German representatives regarding the valuation of the equipment for the projected steel plant, which was to be supplied on credit by the Gutehoffnungshuette Works of Germany. The values placed by the German interests on such equipment, according to the Chinese Minister of Industry, were considerably higher than the Chinese estimates, and the Ministry had consequently decided to send one of its departmental directors, Mr. Huang Ching-tao, to America to seek a neutral and fair estimate from American experts. The two sides have already agreed on the site of the proposed plant and the amount of credit to be supplied by the German interests.

ALUMINIUM WORKS FOR FORMOSA.—On completion of the Jitsugetsutan power station by the Taiwan Electric Power Co., an aluminium manufacturing concern capitalized at Y.10,000,000, is to be founded in Formosa under joint investment of the Mitsui, Mitsubishi, Sumitomo and Furukawa interests. Power will be supplied by the Taiwan Electric organization. The factory will be erected in Takao Province, and materials are to be imported from Borneo, Korea, the Malay Peninsula and Brazil. Approximately 50,000 kw. of electricity will be had from Taiwan Power, and in the first year the firm plans to have an output of 2,000 tons of aluminum, which will be raised eventually to 20,000 tons, enough to make Japan independent of foreign supplies. This metal will be supplied to various industrial plants throughout Japan that manufacture alloys, cables, munitions, etc.

SHANGHAI WATER SUPPLY.—To ensure a supply of water within its own boundaries the French Concession at Shanghai is making a subterranean reservoir divided into four basins, and having a total capacity of 30,000 cubic meters. Water will be taken from the Tongkadou pumping station in Chinese territory, and a sub-pumping station is in course of construction beneath Rue Lafayette, from which the water will flow out under pressure for distribution. Distributors are being laid at a depth of eight and half meters below street level, this being the maximum practicable in Shanghai soil. Two syphons will assist in linking up the sub-station with reservoir basins, which are six and a half metres underground. It is expected to finish the sub-station and connecting conduits by April.

COMMUNICATIONS

SHANGHAI-WUSIH HIGHWAY.—Engineering work on the bridges and culverts of the new highway between Shanghai and Wusih (the industrial center along the Nanking-Shanghai Railway), has been completed. The road covers a distance of over 130 kilometers, and will be opened to traffic early in December.

TELEPHONES FOR FUKIEN.—The installation of a long-distance telephone network linking up the important cities of Foochow, Yenping, Changchow and Amoy is to start immediately. The total outlay amounts to $300,000. Work is to be completed within two months. The services will be under the direct control of the Ministry of Communications.

INTER-KUANG TELEPHONE SERVICE.—Besides its three-year plan for the development of the telephone network in the province, the Kwangtung Provincial Government is proceeding with its scheme for the installation of a long-distance connection with the neighboring province of Kwangsi. The service will first be installed between Canton and Wuchow, eastern Kwangsi, and will be extended to other cities in the two provinces.

RADIO IN CHINA.—With the object of bringing the principal cities along the coast of China closer, the Chinese Maritime Customs has decided to build radio stations at Shanghai, Chefoo, Amoy, Swatow, Kowloon and Kuingchow at an estimated total cost of $200,000. The China Radior Service Corporation has been given sole charge of the installation at the above six stations, the first time in China, it is stated, that radio installation on such a big scale has been undertaken by a Chinese firm with purely Chinese capital.

NINE-PROVINCE TELEPHONE NETWORK.—Negotiations for a loan of $600,000 from the Postal Remittances and Savings Bank for the projected long-distance telephone network, lingking up the nine provinces of Kiangsu, Chekiang, Anhwei, Kiangsi, Hupeh, Hunan, Honan, Shantung and Hopei, have been concluded by the Ministry of Communications. The revenue derived from the Eastern Extension, Great Northern and Commercial Pacific Cable Companies will be deposited in the Postal Remittances and Savings Bank as security.

RAILWAYS

NEW RAILWAY IN ANHWEI.—Train service on the Wuhu-Tunki Railway, in southern Anhwei, was opened to traffic on November 1. This line is part of the projected south-eastern railway linking up Nanking with Shao-an, along the Fukien-Kwangtung border.

HSUCHOW-LINTUNG TRAIN SERVICE.—Direct train service on the Lung-Hai Railway between Hsuchow, north-western Kiangsu, and Lintung, 50 *li* (17 miles) east of Sian, provincial capital of Shensi, was started on November 1. At present, one express will be operated daily.

LUNG-HAI RAILWAY PROGRESS.—January 1, 1935, has been fixed by the Lung-Hai Railway Administration as the date for the inauguration of its entire western extension between Tungkuan, eastern Shensi, and Sian, provincial capital of Shensi. Train service on the extension is being operated as far as Lengkow, 30 miles east of Sian, from Tungkuan. Special efforts are being made by the Railway Administration to complete all engineering work along the section by the end of the year.

TANNA TUNNEL OPENS.—Marking the completion of boring, concrete installation and brick-laying that has covered 16 years and cost Y.25,000,000 and the lives of 67 workmen, a gold-faced brick has been ceremonially installed in the Tanna tunnel, Japan. The big project now enters its final stage, the laying of tracks and installation of electrical equipment. The tunnel is 25,614 feet long, and labor required for its completion amounted to 2,500,000 " men-days." Laying of electric aerials was completed by the end of July, and trial runs of trains were made in October. It is expected that the tunnel will be opened for service December 1. Work on the project was started April 1, 1918.

CHIENTANG RIVER BRIDGE.—Construction work on the projected iron bridge across the Chientang River in Hangchow will be formally started on November 10. The bridge, which is to be built under the joint auspices of the Ministry of Railways and the Chekiang Provincial Government, will span the Chientang River connecting the Hangchow Station of the Shanghai-Hangchow-Ningpo Railway with the Tsingkiang Station of the Hangchow-Kiangshan (Chekiang-Kiangsi) Railway. The cost of the project will total $5,500,000, of which loans for $2,000,000 have been secured from the National Economic Council, $2,000,000 from Shanghai banking circles, and $1,500,000 from the British Boxer Indemnity Funds. It is understood that the steel structural materials will be imported from Great Britain.